

APPENDIX I

SAMPLING AND ANALYSIS PLAN

BASIS OF DESIGN REPORT

JORGENSEN FORGE EARLY ACTION AREA

Prepared for

U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, Washington 98101

On behalf of

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March 2013

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LIST OF ACRONYMS AND ABBREVIATIONS

BODR	Basis of Design Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CQAP	Construction Quality Assurance Plan
EAA	Early Action Area
EE/CA	Engineering Evaluation/Cost Analysis
EMJ	Earle M. Jorgensen
EPA	U.S. Environmental Protection Agency
Facility	Jorgensen Forge facility
FSP	Field Sampling Plan
Jorgensen Forge	Jorgensen Forge Corporation
LDW	Lower Duwamish Waterway
MLLW	mean lower low water
MOU	Memorandum of Understanding
QA/QC	quality assurance and quality control
QAPP	Quality Assurance Project Plan
RAB	removal action boundary
SAP	Sampling and Analysis Plan

1 INTRODUCTION

This Sampling and Analysis Plan (SAP) was prepared on behalf of Earle M. Jorgensen (EMJ) and Jorgensen Forge Corporation (Jorgensen Forge) pursuant to the Administrative Settlement Agreement and Order on Consent for Removal Action Implementation (U.S. Environmental Protection Agency [EPA] Region X Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Docket No. 10-2013-0032) and attached Statement of Work. This SAP is an appendix to the Basis of Design Report (BODR) Final Design submittal for the cleanup of contaminated sediments and associated bank soils in a portion of the Lower Duwamish Waterway (LDW) Superfund Site adjacent to the Jorgensen Forge facility (Facility) located in Tukwila, King County, Washington (see Figure 1 of the BODR; Jorgensen Forge Early Action Area [EAA]). The cleanup will be conducted as a non-time-critical removal action in accordance with EPA's selected cleanup alternative documented in the *Action Memorandum for a Non-Time-Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington* (Action Memo; EPA 2011) and detailed in the *Final Engineering Evaluation/Cost Analysis (EE/CA) – Jorgensen Forge Facility, 8531 East Marginal Way South, Seattle, Washington* (Anchor QEA 2011). The southern portion of the Jorgensen Forge EAA is located near River Miles 3.6 to 3.7 on the east bank of the LDW.

The limits of the Jorgensen Forge EAA are referred to as the removal action boundary (RAB). The RAB extends from the top of the bank at approximately +19 to +20 feet mean lower low water (MLLW; or top of the sheetpile/concrete panel on the southern portion of the Facility) to the federal navigation channel. The RAB is bounded to the north by The Boeing Company Plant 2 Duwamish Sediment Other Area and Southwest Bank Corrective Measure EAA cleanup area, as specified in the EPA-approved Memorandum of Understanding (MOU; EMJ et al. 2007). EPA identified this cleanup area as the northern portion of the Jorgensen Forge EAA.

This SAP provides the Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) as Attachments 1 and 2, respectively. The QAPP describes the quality assurance and quality control (QA/QC) procedures that will be implemented as part of the construction phase for the removal action. The purpose of the QAPP is to ensure that the data generated are of

sufficient quality to meet the sampling objectives as described in the BODR and Construction Quality Assurance Plan (CQAP; Appendix D to the BODR). The FSP addresses the collection of data required during the construction phase of the removal action. The data will be used for verification and documentation purposes during the construction phase of the removal action as well as completion of the long-term monitoring performed in accordance with the CQAP, Water Quality Monitoring Plan (Appendix E to the BODR), and Long-term Operations, Monitoring, and Maintenance Plan (Appendix F to the BODR).

Refer to Attachment 1 and Attachment 2 for a detailed summary of the QA/QC procedures and field sampling procedures that will be completed during the construction phase of the removal action.

2 REFERENCES

- Anchor QEA, 2011. *Final Engineering Evaluation/Cost Analysis – Jorgensen Forge Facility, 8531 East Marginal Way South, Seattle, Washington*. Prepared for the U.S. Environmental Protection Agency. March 2011.
- Earle M. Jorgensen (EMJ), Jorgensen Forge Corporation, and The Boeing Company, 2007. Memorandum of Understanding: Coordination at the Boeing and EMJ/Jorgensen Transition Zone Boundary Sediment Cleanup Areas; Lower Duwamish Waterway (MOU). September 2007.
- EPA, 2011. *Action Memorandum for a Non-Time-Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington*. Seattle, Washington.

ATTACHMENT 1

QUALITY ASSURANCE PROJECT PLAN

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
BODR	Basis of Design Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chain-of-custody
CQAP	Construction Quality Assurance Plan
DQO	data quality objective
EAA	Early Action Area
EDD	electronic data deliverable
EMJ	Earle M. Jorgensen Company
EPA	U.S. Environmental Protection Agency
Facility	Jorgensen Forge facility
FC	Field Coordinator
FSP	Field Sampling Plan
Jorgensen Forge	Jorgensen Forge Corporation
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LDW	Lower Duwamish Waterway
MLLW	mean lower low water
MOU	Memorandum of Understanding
MS	matrix spike
MSD	matrix spike duplicate
OMMP	Operations, Monitoring, and Maintenance Plan
PCB	polychlorinated biphenyl
PSEP	Puget Sound Estuary Program
PSSRM	Puget Sound Sediment Reference Material
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAB	removal action boundary
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SOP	standard operating procedure

SRM

Standard reference materials

1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) was prepared on behalf of Earle M. Jorgensen (EMJ) and Jorgensen Forge Corporation (Jorgensen Forge) pursuant to the Administrative Settlement Agreement and Order on Consent for Removal Action Implementation (U.S. Environmental Protection Agency [EPA] Region X Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Docket No. 10-2013-0032) and attached Statement of Work. This QAPP is Attachment 1 to the Sampling and Analysis Plan (SAP), which is an appendix to the Basis of Design Report (BODR) Final Design submittal for the cleanup of contaminated sediments and associated bank soils in a portion of the Lower Duwamish Waterway (LDW) Superfund Site adjacent to the Jorgensen Forge facility (Facility) located in Tukwila, King County, Washington (see Figure 1 of the BODR; Jorgensen Forge Early Action Area [EAA]). The cleanup will be conducted as a Non-Time Critical Removal Action in accordance with EPA's selected cleanup alternative documented in the *Action Memorandum for a Non-Time Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington* (EPA 2011) and detailed in the *Final Engineering Evaluation/Cost Analysis – Jorgensen Forge Facility, 8531 East Marginal Way South, Seattle, Washington* (Anchor QEA 2011). The Jorgensen Forge EAA is located near River Miles 3.6 to 3.7 on the east bank of the LDW, as shown on Figure 1.

The limits of the Jorgensen Forge EAA (herein referred to as the removal action boundary [RAB]) are shown on Figure 2. The RAB extends from the top of the bank at approximately +19 to +20 feet mean lower low water (MLLW; or top of the sheetpile/concrete panel on the southern portion of the Facility) to the federal navigation channel. The RAB is bounded to the north by The Boeing Company Plant 2 Duwamish Sediment Other Area and Southwest Bank Corrective Measure EAA cleanup area, as specified in the EPA-approved Memorandum of Understanding (MOU; EMJ et al. 2007). EPA identified this cleanup area as the northern portion of the Jorgensen Forge EAA.

This QAPP describes the quality assurance and quality control (QA/QC) procedures that will be implemented as part of the construction phase for the removal action. The purpose of the QAPP is to ensure that the data generated are of sufficient quality to meet the sampling

objectives as described in the BODR and Construction Quality Assurance Plan (CQAP; Appendix D to the BODR).

This QAPP was prepared in accordance with the EPA's *Requirements for Quality Assurance Project Plans* (EPA 2001a), *EPA Guidance for Quality Assurance Project Plans* (EPA 1998), and *EPA Requirements for Quality Management Plans* (EPA 2001b). Chemistry analytical laboratory work will be performed in accordance with the specified analytical methods, the data quality objectives (DQOs), and this QAPP. The QAPP should be reviewed with the Field Sampling Plan (FSP; Attachment 2 to the SAP), CQAP (Appendix D to the BODR), and Water Quality Monitoring Plan (Appendix E of the BODR).

2 PROJECT MANAGEMENT

This section identifies key project personnel, describes the rationale for conducting the monitoring studies, identifies the studies to be performed and their respective schedules, outlines project DQOs and criteria, lists training and certification requirements for sampling personnel, and describes documentation and record-keeping procedures.

2.1 Project/Task Organization

Responsibilities of the team members, as well as laboratory project managers, are described in the following paragraphs.

Because the individuals listed below may change over time, this QAPP has been written to include “designee” as an alternate to the current project organization. The following paragraphs define their functional responsibilities.

The EMJ Project Manager is **Amy Essig Desai** of Farallon Consulting, LLC. The primary role of the Project Manager is to ensure compliance with the requirements.

The EPA Project Manager is **Rebecca Chu**.

The Anchor QEA, LLC (Anchor QEA) Project Manager is **David Templeton** and the Anchor QEA Project Lead is **Ryan Barth**. The Anchor QEA Project Manager and Project Lead will act as the direct line of communication between Anchor QEA and EMJ and Jorgensen Forge, and are responsible for implementing activities described in this QAPP. They will also be responsible for production of work plans, producing all project deliverables, and performing the administrative tasks needed to ensure timely and successful completion of these studies. The Anchor QEA Project Manager will provide the overall programmatic guidance to support staff and will ensure that all documents, procedures, and project activities meet the objectives contained within this QAPP. The Anchor QEA Project Manager and Project Lead will also be responsible for resolving project concerns or conflicts related to technical matters.

Nathan Soccorsy will serve as the Anchor QEA Field Coordinator (FC). The FC is responsible for day-to-day technical and QA/QC oversight. He will ensure that appropriate protocols for sample collection, preservation, and holding times are observed and will submit environmental samples to the designated laboratories for chemical and physical analyses.

Delaney Peterson will serve as the Anchor QEA QA/QC Manager. She will provide QA oversight for both the field sampling and laboratory programs, ensuring that samples are collected and documented appropriately, coordinating with the analytical laboratories, ensuring data quality, overseeing data validation, and supervising project QA coordination and data validation.

Laurel Menoche will serve as the Anchor QEA Data Manager. She will compile field observations and analytical data into a database, review the data for completeness and consistency, append the database with qualifiers assigned by the data validator, and ensure that the data obtained is in a format suitable for inclusion in the appropriate databases and delivery to the EPA.

Sue Dunnihoo of Analytical Resources Incorporated will serve as the Laboratory Manager and will oversee all laboratory operations associated with the receipt of the environmental samples, chemical/physical analyses, and laboratory report preparation for this project. **Stella Cuenco** of Laboratory Data Consultants will serve as the primary contact to perform all applicable data validation.

The analytical testing laboratories will be responsible for the following:

- Perform the methods outlined in this QAPP, including those methods referenced for each analytical procedure
- Follow documentation, custody, and sample logbook procedures
- Implement QA/QC procedures required by Puget Sound Estuary Program (PSEP; 1986, 1997a, 1997b, 1997c) or other guidelines
- Meet all reporting and QA/QC requirements
- Deliver electronic data files as specified in this QAPP
- Meet turnaround times for deliverables as described in this QAPP
- Allow EPA and the QA/QC contractor to perform laboratory and data audits

3 DATA QUALITY OBJECTIVES

DQOs provide a qualitative and quantitative framework and series of planning steps based on the scientific method around which data collection programs can be designed. The use of DQOs ensures that:

- The objectives of the investigation are clearly defined
- The type, quantity, and quality of environmental data used in decision making are appropriate for their intended application
- Acceptable levels of decision error and performance goals are specified, such that the quantity and quality of data needed to support management decisions are provided

The DQOs are further described below.

3.1 Data Use and Type

Pre- and post-construction surface sediment chemical data will be collected as described in the Operations, Monitoring, and Maintenance Plan (OMMP; Appendix F to the BODR) and CQAP. Data collection approaches and objectives are discussed in detail in the respective plans and summarized as follows:

- **CQAP.** Perimeter surface sediment monitoring will be performed to evaluate whether there are significant increases in concentrations of chemicals of concern in surface sediments adjacent to the RAB relative to their pre-remediation concentrations due to releases from the construction activities. Post-removal and pre-backfill Z-layer surface sampling will be performed to document the sediment quality underlying the placed clean backfill material. Post-excavation and pre-backfill layer bank soil sampling will be performed to document the soil quality beneath the placed clean backfill material.
- **OMMP.** Post-construction long-term surface sediment monitoring will be performed to confirm that performance standards are being met in the years following construction, and to demonstrate that Facility source controls are effectively protecting the quality of the adjacent river sediments and preventing their recontamination.
- **WQMP.** Surface water sampling will be performed during removal activities to

monitor water quality during in-water construction activities.

3.2 Measurement Quality Objectives for Chemical Data

Reporting limit goals for sediment and water sampling parameters are presented in Tables 1 and 5.

The measurement of quality objectives for the chemistry data will assess precision, accuracy, representativeness, comparability, and completeness of the data (as detailed in Section 6.3 of this appendix). Project-specific control limits will be used to assess analytical performance with regard to precision and accuracy and are outlined in Table 2. Data representativeness will be addressed by the sample quantities and locations identified in the OMMP (Appendix F to the BODR) and CQAP. Data comparability will be achieved through the use of standard EPA-approved methods. Data completeness will be assessed at the conclusion of analytical activities.

4 ANALYTICAL METHODS

Sampling will be performed in accordance with the methods presented in the FSP (Attachment 2 to the SAP). Sediment and water samples submitted for analysis will be analyzed for a variety of parameters, including total polychlorinated biphenyls (PCBs) and metals. In addition, sediment samples will be analyzed for total organic carbon, total solids and grain size. Bank soil samples submitted for analysis will be analyzed for the full Washington State Department of Ecology Sediment Management Standards list of analytes. Analyte lists, analytical methods, and target reporting limits are outlined in Table 1 for surface sediment and soil samples and Table 5 for water samples.

Tables 1 and 5 present the methods of analysis and reporting limit goals. The laboratory standard operating procedure (SOP) provided by the contracted analytical laboratory will describe the chemical analytical procedures in detail. These SOPs will be maintained in the analytical laboratory's file.

The laboratory will provide Level IV data reports for all data in order to complete the required level of validation.

4.1 Reporting Limits

In general, reporting limit goals for sediment are based on dry weight and assume 50 percent total solids content in the sediment samples. If the total solids content is less than 50 percent, sample reporting limits may increase. Interferences in individual water, sediment, and soil samples may also result in increased reporting limits. To achieve the required low reporting limits, some modifications to the methods may be necessary. These modifications from Standard SW846 methodology protocol will be provided by the laboratory at the time of sample submittal, and any modifications to the methods will be documented in the case narrative that accompanies the final report.

5 SAMPLE HANDLING, CHAIN-OF-CUSTODY, AND RECEIPT

Sample documentation is a critical aspect of environmental investigations. Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis, to the time sample results are potentially introduced as evidence. A sample log form and field logbook entries will be completed for each location occupied and each sample collected. Documentation procedures for sampling are provided in greater detail in the FSP (Attachment 2 to the SAP).

5.1 Sample Containers, Preservation, and Holding Time Requirements

Pre-cleaned, certified sample containers, which will be provided by the contract analytical laboratory, must be used for all sediment and water samples that will be analyzed by the laboratory. Specific types and sizes of containers for each parameter, as well as holding time and preservation requirements, are listed in Table 3.

Sample containers for conventional parameters, metals, and organics will be cleaned to EPA protocols. Certifications attesting to the cleanliness of pre-cleaned containers are required for containers used for organic analyses and will be maintained by the laboratory.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled and labeled containers will be placed in a cooler on ice (see below) and carefully packed to eliminate the possibility of container breakage.

5.2 Sample Packing, Handling, and Shipping

Sample packaging and shipment procedures are designed to ensure that the samples will arrive at the laboratory with the chain-of-custody (COC) form intact. Samples will either be hand-delivered to the laboratory or be delivered via courier.

Samples will be packaged for shipment as outlined below:

1. Ensure that sample labels are securely affixed to sample containers with clear packing tape, if necessary.
2. Check the caps on the sample containers to ensure that they are properly sealed.

3. Complete the COC form with the required sampling information and ensure that the recorded information matches the sample labels. Note: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the COC prior to this transfer. The appropriate personnel will sign and date the COC form to document the sample custody transfer.
4. Wrap sample containers in bubble wrap or other cushioning material.
5. Place sample containers in zip-top bags to prevent any possible cross-contamination.
6. Place 1 to 2 inches of cushioning material at the bottom of the cooler.
7. Place the sealed sample containers and a temperature blank in the cooler.
8. Place ice in plastic bags and seal. Place the ice-filled bags loosely in the cooler.
9. Fill the remaining space in the cooler with cushioning material.

Samples will be packaged by the field personnel and transported as low-concentration environmental samples. The samples will either be delivered by an express carrier or will be picked up by a laboratory courier. Shipments will be accompanied by the COC form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the COC form as long as the forms are sealed inside the sample coolers and the custody seals remain intact.

5.3 Sample Receipt

All samples received at the laboratory will be carefully checked for label identification and complete, accurate COC documentation. The condition of the samples will be checked, and the temperature blank will be measured and recorded (with a calibrated digital thermometer) immediately after the cooler is opened. These results, along with any questions or comments regarding sample integrity, will be recorded on the COC form (or the appropriate laboratory cooler receipt form). The laboratory will contact Anchor QEA immediately if discrepancies between the samples and COC records are found upon receipt. If it is necessary for the receiving laboratory to ship samples to other laboratories, a COC form will be completed and will accompany the samples. A copy of the COC form (and

cooler receipt form) will be emailed to Anchor QEA within 2 days of sample receipt and included in the final analytical data report.

Once received at the laboratory, the samples will be maintained at 4 ± 2 degrees Celsius ($^{\circ}\text{C}$), unless it is required that the samples be held at a lower temperature (not less than $-20 \pm 10^{\circ}\text{C}$) to extend the holding time.

If a sample container is received broken, a sample is received in an inappropriate container, or a sample has not been preserved by appropriate means, the laboratory will notify Anchor QEA as soon as possible on the day of sample receipt. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling each sample bottle with its laboratory identification number, and moving the samples to appropriate storage locations to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

6 QUALITY ASSURANCE PROCEDURES

This section describes the laboratory and field QA procedures to be followed to ensure data are of known and acceptable precision and accuracy so that project objectives are achieved. These procedures include instrument preventative maintenance, calibration procedures and frequency of calibration, and analytical and field QC requirements.

6.1 Preventive Maintenance

Preventive maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call to the manufacturer. If the instrument malfunction is of a nature to impact the project's turnaround time, this must be communicated to the Anchor QEA QA Manager as soon as the malfunction is discovered so that contingencies for analysis can be coordinated.

Maintenance schedules for laboratory equipment will adhere to the manufacturers' recommendations. Records will reflect the complete history of each instrument and specify the timeframe for future maintenance. Major repairs or maintenance procedures will be performed through service contracts with manufacturers or by qualified contractors. Paperwork associated with service calls and preventive maintenance calls will be kept on file by the laboratory.

Laboratory systems managers are responsible for the routine maintenance of instruments used in a particular laboratory. Any routine preventive maintenance carried out is logged into the appropriate logbooks. Routine and non-routine maintenance schedules and procedures will be performed in accordance with the laboratory's QA manual.

All major instruments will be backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts will also be available to minimize equipment/instrument downtime.

6.2 Calibration Procedures and Frequency

When analyses are conducted according to EPA methods, the calibration procedures and frequencies specified in the applicable method will be followed. For analyses governed by SOPs, see the appropriate laboratory SOP for the required calibration procedures and frequencies. Records of calibrations will be filed and maintained by the laboratory. These records may be subject to a QA audit.

All standards used in the calibration of equipment will be traceable, directly or indirectly, to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable, commercial sources. All standards received shall be logged into standard receipt logs maintained by the individual analytical groups. Each group shall maintain a standards log that tracks the preparation of standards used for calibration and QC purposes.

6.3 Laboratory Quality Control Requirements

The overall QA objective of this QAPP is to develop and implement procedures for sampling, COC, laboratory analysis, instrument calibration, data reduction and reporting, internal QC, audits, preventive maintenance, and corrective action such that valid data will be generated. These procedures are presented or referenced in the following sections of the QAPP. Specific QC checks are discussed in Section 6.5 of this document.

QA indicators are generally defined in terms of five parameters:

- Precision
- Accuracy
- Representativeness
- Comparability
- Completeness

Each parameter is defined below. Specific QA objectives for sample collection and analyses are set forth in other sections of this QAPP as referenced below.

6.3.1 Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work for this project will adhere to established protocols as presented in this QAPP. Analytical precision will be measured through laboratory control sample/laboratory control sample duplicates (LCS/LCSDs), as well as matrix spike/matrix spike duplicates (MS/MSDs) for organic analyses and laboratory duplicate samples for inorganic analyses. Analytical precision measurements will be carried out on project-specific samples at a minimum frequency of one per laboratory analysis group or one in 20 samples, whichever is more frequent, per matrix analyzed as outlined in Table 4. Laboratory precision will be evaluated against project-required control limits outlined in Table 2.

Field precision will be evaluated by the collection of blind field duplicates at a frequency of 5 percent. Field duplicate precision will be screened against a relative percent difference (RPD) of 50 percent for sediment samples and 35 percent for water samples. However, no data will be qualified based solely on field duplicate precision.

The equation used to express precision is:

$$RPD = \frac{(A-B)}{\frac{(A+B)}{2}} \times 100\% \quad (1-1)$$

where:

A = Analytical result from one of two duplicate measurements

B = Analytical result from the second measurement

Precision measurements can be affected by how close a chemical concentration is to the reporting limit, which can increase the percent error (expressed as RPD). When a sample or duplicate concentration is within five times the reporting limit, alternative control limits recommended by the EPA (1999) of two times +/- the reporting limit for sediment samples, and one time +/- the reporting limit for waters will be used.

6.3.2 Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, MS, blank spikes, LCS, and surrogate standards will be used to assess the accuracy of the analytical data. Accuracy measurements will be carried out at a minimum frequency of one per 20 samples per matrix analyzed. Because MS/MSDs measure the effects of potential matrix interferences for a specific matrix, the laboratory will report MS/MSDs only on project-specific samples. Surrogate recoveries will be determined for every sample analyzed for organics.

Laboratory accuracy will be evaluated against project-specific control limits outlined in Table 2. Accuracy can be expressed as a percentage of the true or reference value, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is:

$$\text{Percent Recovery} = \frac{A-X}{B} \times 100\% \quad (1-2)$$

where:

A = Value measured in spiked sample or standard

X = Value measured in original sample

B = True value of amount added to sample or true value of standard

6.3.3 Representativeness

Representativeness is the degree to which sample data accurately and precisely represent conditions in the project area. Representativeness is dependent on sampling and analytical variability and the variability of environmental media. The FSP (Attachment 2 to the SAP) has been designed to assess the presence of the chemical constituents at the time of sampling and presents the rationale for sample quantities and sampling locations. In addition, the use of the prescribed field and laboratory analytical methods, with their associated holding times and preservation requirements, is intended to provide representative data.

6.3.4 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP and through the use of established QA/QC procedures and appropriately trained personnel.

6.3.5 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event or investigation compared to the total amount that was obtained. Completeness will be calculated as follows:

$$C = \frac{[(\text{number of acceptable data points}) \times 100]}{(\text{total number of data points collected})} \quad (1-3)$$

where:

C = completeness

The DQO for completeness for all components of this project is 95 percent. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been qualified as rejected will not be considered valid for the purpose of assessing completeness.

6.4 Field Quality Control Checks

Field QC samples include field equipment blanks and field duplicates and will be analyzed to identify possible problems resulting from sample collection or sample processing in the field. All field QC samples will be documented in the field logbook and verified by the Project QA Manager or designee.

6.4.1 Field Equipment Blanks

Field equipment blanks are used to determine whether cross contamination has occurred during sampling. A minimum of one rinsate blank of the sediment or soil sample device and processing equipment will be submitted per sampling event. For surface water samples, a

minimum of one rinsate blank of the water sampling device will be submitted during the project.

6.4.2 Field Duplicates

A minimum of one field duplicate will be collected per 20 samples submitted for analysis for each media and will be evaluated as described Section 6.3.1.

6.5 Analytical Laboratory Quality Control Checks

Internal laboratory QC checks will be used to monitor data integrity. These checks will include method blanks, MSs (and MSDs), LCSs (and LCSDs), internal standards, surrogate standards, calibration standards, and reference material standards. Project-required control limits will be used to evaluate MS/MSD and LCS/LCSD percent recoveries and RPD values. Surrogate recoveries will be evaluated using laboratory control limits. Laboratory control charts will be used to determine long-term instrument trends.

Results of QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits have been exceeded. If control limits are grossly exceeded in the sample group, the Project QA Manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing of the affected samples) will be initiated prior to processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project will be traceable to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable, commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities found in a standard will be documented.

6.5.1 Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. The method blank for all analyses must be less than the method reporting limit of any single target analyte/compound. If a laboratory method blank

exceeds this criterion for any analyte/compound, and the concentration of the analyte/compound in any of the samples is less than five times the concentration found in the blank (10 times for common contaminants), analyses must stop and the source of contamination must be eliminated or reduced.

6.5.2 *Laboratory Control Samples*

LCSs are prepared and analyzed to assess possible laboratory bias at all stages of sample preparation and analysis. The LCS is a matrix-dependent spiked sample prepared at the time of sample preparation along with the preparation of samples, method blanks, and MSs. The LCS will provide information on the accuracy of the analytical process, and when analyzed in duplicate, will provide precision information as well.

6.5.3 *Matrix Spike/Matrix Spike Duplicate*

MS/MSDs will be performed on project-specific samples at a frequency of 5 percent or per analytical batch, whichever is more frequent. Analysis of MS samples provides information on the preparation and/or analytical efficiency of the method for the sample matrix. By performing duplicate MS analyses, information on the precision of the method is also provided. MS/laboratory duplicates can be performed in place of MS/MSDs for inorganic analyses for precision information.

6.5.4 *Surrogate Spikes*

Surrogates are compounds that are unlikely to occur under natural conditions and have properties similar to the analytes of interest. Surrogates are added to the samples prior to purging or extraction and are primarily used for organic samples analyzed by gas chromatography/mass spectrometry and gas chromatography methods. The surrogate spike provides broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to the sample matrix. All project samples and associated sample QC to be analyzed by organic methods will be spiked with appropriate surrogate compounds as defined in the analytical methods.

6.5.5 Laboratory Duplicates

For inorganic analyses, laboratory duplicates will be analyzed to assess laboratory precision. A laboratory duplicate is defined as a separate aliquot of a sample that is analyzed as a separate sample.

6.5.6 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide information regarding instrument stability and validity of the instrument calibration. The analytical frequency of calibration check standards is specified by the analytical method.

6.5.7 Standard Reference Materials

Standard reference materials (SRMs) are substances of the same or similar matrix to the project samples and contain a known concentration of target analyte(s). These materials are prepared and analyzed in the same manner as routine samples and in the same preparation and analytical batch. The recovery of the target analyte(s) provide information on interferences caused by the sample matrix. The Puget Sound Sediment Reference Material (PSSRM) for PCBs will be used for sediment samples.

7 DATA MANAGEMENT

All data will undergo two levels of QA/QC evaluation: one at the laboratory and one by a qualified data validator. Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the appropriate analytical protocols and the laboratory's QA manual. QC data resulting from methods and procedures described in this document will also be reported.

7.1 Sample Management

All laboratory analytical batches will be assigned a unique number and tracking identifier at the laboratory. All data reports will include this tracking number. The laboratory will use a laboratory information management system to track all samples throughout the analytical process.

7.2 Data Reporting

Analytical chemistry results will be provided by the laboratory in digital and electronic deliverable formats. The data packages will be reviewed to ensure that the correct analyses were performed for each sample submitted and that all of the analyses requested on the COC form were performed. If discrepancies are noted, the Project QA Manager will be notified and will promptly follow up with the laboratory to resolve any issues.

Following completion of data validation, the digital files will be used to generate the appropriate report tables. Electronic data deliverables (EDDs) will be supplied by the laboratory in Anchor QEA's custom EQUIS electronic format. Laboratory data, which is electronically provided and loaded into the database, will undergo a 10 percent check against the laboratory data deliverable. Data will be validated or reviewed manually, and qualifiers, if assigned, will be entered manually. All manually entered data will be verified by a second party. Data tables and reports are exported from EQUIS to Microsoft Excel tables as needed.

Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually. After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

7.3 Data Management Procedures

A record of all field documentation, as well as analytical and QA/QC results, will be maintained to ensure the validity of the data. To effectively execute such documentation, carefully constructed sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms, as described in the FSP (Attachment 2 to the SAP) and summarized in Section 5 of this QAPP. Copies of all completed COC forms will be maintained in the project files. The laboratory shall verify receipt of the samples electronically within 48 hours of sample receipt.

When analytical data are received from the laboratory, the Project QA Manager will review the incoming analytical data packages and compare the information to the COCs to confirm that the correct analyses were performed for each sample, and that results were received for all samples submitted for analyses. Any discrepancies noted will be promptly followed up by the Project QA Manager.

7.4 Laboratory Turnaround Time

The laboratory turnaround time for completed data is 3 weeks from sample receipt to the completion of the complete data report. Preliminary water quality COC data will be requested within 48 to 72 hours from sample receipt.

7.5 Archival/Retention Requirements

Archival sediment samples will be stored in the dark at $-18 \pm 10^{\circ}\text{C}$ for possible additional analyses or reanalyses. Archive sample aliquots will be retained for a minimum of 1 year after the collection date. The laboratory will notify the Project QA Manager prior to disposing of any samples.

8 DATA ASSESSMENT PROCEDURES

Once the data are received from the laboratory, a number of QC procedures will be followed to accurately evaluate data quality and assess data precision, accuracy, and completeness.

8.1 Data Quality Control Review

Chemistry data will be subject to multilevel review by the selected analytical laboratory. The group leader will review all data reports prior to their release for final data report generation. The laboratory QA manager will review the final data reports, and the laboratory project manager will review a cross section of the final data reports prior to delivery to Anchor QEA.

If discrepancies or deficiencies exist in the analytical results, then corrective action will be taken, as discussed in Section 9.

8.2 Data Validation and Verification

All data will undergo Stage 2B data validation (EPA 2009). Data validation will be performed under the guidance of the EPA's National Functional Guidelines (EPA 1999, 2004, 2005, 2008) and in accordance with this QAPP. The following will be reviewed as appropriate to the stage of data validation being performed and as applicable to the analysis:

- COC forms
- Holding times
- Instrument tunes and calibration
- Method blanks
- Surrogate recoveries
- MS/MSD recoveries and RPD values
- LCS/LCSD recoveries and RPD values
- Field duplicate RPD values
- Laboratory duplicate RPD values
- Detection and reporting limits

The results of the data quality review, including text assigning qualifiers in accordance with the EPA National Functional Guidelines and a tabular summary of qualifiers, will be generated by the data validator and submitted to the project QA/QC manager for final review and confirmation of the validity of the data. Copies of the validation reports will be submitted and presented as an appendix to the applicable data reports.

9 LABORATORY AUDITS AND CORRECTIVE ACTIONS

Laboratory and field performance audits and corrective action procedures are described in this section.

9.1 Laboratory and Field Performance Audits

Laboratory and field performance audits consist of onsite reviews of QA systems and equipment for sampling, calibration, and measurement. Laboratory audits will not be conducted for this project; however, all laboratory audit reports will be made available to the Project QA Manager upon request. All laboratories are required to have written procedures addressing internal QA/QC; these procedures will be submitted and will be reviewed by the Project QA Manager to ensure compliance with this QAPP. All laboratories must ensure that personnel engaged in sampling and analysis tasks have appropriate training.

The laboratory will, as part of the audit process, provide written details of any and all planned modifications for Anchor QEA's review.

9.2 Corrective Action Procedures

The following sections describe corrective action procedures for field and laboratory procedures.

9.2.1 Corrective Action for Field Sampling

The FC will be responsible for correcting equipment malfunctions during the field sampling effort. The Project QA Manager will be responsible for resolving situations in the field that may result in non-compliance with the QAPP. All corrective measures will be immediately documented in the field logbook.

9.2.2 Corrective Action for Laboratory Analyses

The laboratory is required to submit and comply with its SOPs. The laboratory project manager will be responsible for ensuring that appropriate corrective actions are initiated as required for compliance with this QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

If QC results exceed the laboratory control limits, the analyst will identify and correct the anomaly before continuing with the sample analyses, if possible. If the QC exceedance cannot be overcome with standard corrective action (e.g., repreparation and/or reanalysis), the causes of the exceedance and steps taken to overcome them will be discussed by the laboratory project manager in the data package narrative. If the exceedances are gross or widespread, the Project QA Manager will be notified immediately and the appropriate corrective action will be decided.

10 REFERENCES

- Anchor QEA, 2011. *Final Engineering Evaluation/Cost Analysis – Jorgensen Forge Facility, 8531 East Marginal Way South, Seattle, Washington*. Prepared for the U.S. Environmental Protection Agency. March.
- Earle M. Jorgensen (EMJ), Jorgensen Forge Corporation, and The Boeing Company, 2007. *Memorandum of Understanding: Coordination at the Boeing and EMJ/Jorgensen Transition Zone Boundary Sediment Cleanup Areas; Lower Duwamish Waterway* (MOU). September 2007.
- EPA, 1998. *EPA Guidance for Quality Assurance Project Plans*. EPA QA/G-5. EPA/600R-98/018. February.
- EPA, 1999. *EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*. U.S. Environmental Protection Agency, Office of Emergency Response. EPA 540/R-99/008. October.
- EPA, 2001a. *EPA Requirements for Quality Assurance Project Plans*. EPA QA/R-5. EPA/240/B-01/003. March.
- EPA, 2001b. *EPA Requirements for Quality Management Plans*. EPA QA/R-2. EPA/240/B-01/002. March.
- EPA, 2004. *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation (OSRTI). EPA 540-R-04-004. October 2004.
- EPA, 2005. *EPA Contract Laboratory Program National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Data Review*. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation (OSRTI). EPA 540-R-05-001. September.
- EPA, 2008. *EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. EPA 540-R-08-01. June.

- EPA, 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. U.S. Environmental Protection Agency. EPA540-R-08-005. January.
- EPA, 2011. *Action Memorandum for a Non-Time-Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington*. Seattle, Washington.
- PSEP, 1986. *Recommended protocols for measuring conventional sediment variables in Puget Sound*. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, Washington.
- PSEP, 1997a. *Puget Sound Estuary Program: Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound*. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington.
- PSEP, 1997b. *Puget Sound Estuary Program: Recommended Guidelines for Measuring Organic Compounds in Puget Sound Sediment and Tissue Samples*. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington.
- PSEP, 1997c. *Puget Sound Estuary Program: Recommended Protocols for Measuring Metals in Puget Sound Sediment and Tissue Samples*. Prepared for the U.S. Environmental Protection Agency Region 10, and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington.

TABLES

Table 1
Sediment and Soil Sampling Parameters, Analytical Methods, and Chemical Criteria

Parameter	Analytical Method	Units	Ecology 2003 Freshwater Criteria ^d		Sediment Management Standards Criteria ^d		SAPA Recommended Practical Quantitation Limit (PQL) ^b	Laboratory PQL
			LAET	2LAET	Sediment Quality Standards	Cleanup Screening Level		
Conventional Parameters								
Grain size	PSEP, 1986	%	--	--	--	--	1	1.0
Total solids	PSEP, 1986	% wet wt	--	--	--	--	0.1	0.01
Total organic carbon (TOC)	PSEP, 1986	% dry wt	--	--	--	--	0.1	0.05
Total sulfides	PSEP, 1986	% dry wt	--	--	--	--	10	1.0
Ammonia	Plumb, 1981	mg-N/kg dry wt	--	--	--	--	100	1.0
Metals								
Arsenic	6010B/6020	mg/kg dry wt	31.4	50.9	57	93	19	0.2
Cadmium	6010B/6020	mg/kg dry wt	2.39	2.9	5.1	6.7	1.7	0.2
Chromium	6010B/6020	mg/kg dry wt	95	133	260	270	87	0.5
Copper	6010B/6020	mg/kg dry wt	619	829	390	390	130	0.5
Lead	6010B/6020	mg/kg dry wt	335	431	450	530	150	0.2
Mercury	7471A	mg/kg dry wt	0.8	3.04	0.41	0.59	0.14	0.025
Silver	6010B/6020	mg/kg dry wt	0.545	3.5	6.1	6.1	2	0.2
Zinc	6010B/6020	mg/kg dry wt	683	1080	410	960	137	4.0
SVOCs								
PAHs								
Total LPAH	8270D	µg/kg dry wt	6,590	9,200	370 mg/kg OC	780 mg/kg OC	--	--
Naphthalene	8270D	µg/kg dry wt	529	1,310	99 mg/kg OC	170 mg/kg OC	700	20
Acenaphthylene	8270D	µg/kg dry wt	470	640	66 mg/kg OC	66 mg/kg OC	433	20
Acenaphthene	8270D	µg/kg dry wt	1,060	1,320	16 mg/kg OC	57 mg/kg OC	167	20
Fluorene	8270D	µg/kg dry wt	1,070	3,850	23 mg/kg OC	79 mg/kg OC	180	20
Phenanthrene	8270D	µg/kg dry wt	6,100	7,570	100 mg/kg OC	480 mg/kg OC	500	20
Anthracene	8270D	µg/kg dry wt	1,230	1,580	220 mg/kg OC	1,200 mg/kg OC	320	20
2-Methylnaphthalene ^a	8270D	µg/kg dry wt	469	555	38 mg/kg OC	64 mg/kg OC	223	20
Total HPAHs	8270D	µg/kg dry wt	31,640	54,800	960 mg/kg OC	5,300 mg/kg OC	--	--
Fluoranthene	8270D	µg/kg dry wt	11,100	15,000	160 mg/kg OC	1,200 mg/kg OC	567	20
Pyrene	8270D	µg/kg dry wt	8,790	16,000	1,000 mg/kg OC	1,400 mg/kg OC	867	20
Benzo(a)anthracene	8270D	µg/kg dry wt	4,260	5,800	110 mg/kg OC	270 mg/kg OC	433	20
Chrysene	8270D	µg/kg dry wt	5,940	6,400	110 mg/kg OC	460 mg/kg OC	467	20
Total benzo(b+k)fluoranthenes	8270D	µg/kg dry wt	11,000	13,800	230 mg/kg OC	450 mg/kg OC	1,067	40
Benzo(a)pyrene	8270D	µg/kg dry wt	3,300	4,810	99 mg/kg OC	210 mg/kg OC	533	20
Indeno(1,2,3-cd)pyrene	8270D	µg/kg dry wt	4,120	5,300	34 mg/kg OC	88 mg/kg OC	200	20
Dibenz(a,h)anthracene	8270D	µg/kg dry wt	800	839	12 mg/kg OC	33 mg/kg OC	77	20
Benzo(g,h,i)perylene	8270D	µg/kg dry wt	4,020	5,200	31 mg/kg OC	78 mg/kg OC	223	20
Chlorinated Benzenes								
1,2-Dichlorobenzene	8270D-SIM	µg/kg dry wt	--	--	2.3 mg/kg OC	2.3 mg/kg OC	35	5.0
1,4-Dichlorobenzene	8270D-SIM	µg/kg dry wt	--	--	3.1 mg/kg OC	9 mg/kg OC	37	5.0
1,2,4-Trichlorobenzene	8270D-SIM	µg/kg dry wt	--	--	0.81 mg/kg OC	1.8 mg/kg OC	31	5.0
Hexachlorobenzene	8270D-SIM	µg/kg dry wt	--	--	0.38 mg/kg OC	2.3 mg/kg OC	22	5.0
Phthalates								
Dimethyl phthalate	8270D-SIM	µg/kg dry wt	311	436	53 mg/kg OC	53 mg/kg OC	24	5.0
Diethyl phthalate	8270D-SIM	µg/kg dry wt	--	--	61 mg/kg OC	110 mg/kg OC	67	5.0
Di-n-butyl phthalate	8270D	µg/kg dry wt	103	--	220 mg/kg OC	1,700 mg/kg OC	467	20
Butyl benzyl phthalate	8270D-SIM	µg/kg dry wt	260	366	4.9 mg/kg OC	64 mg/kg OC	21	5.0
Bis(2-ethylhexyl) phthalate	8270D	µg/kg dry wt	2,520	6,380	47 mg/kg OC	78 mg/kg OC	433	25
Di-n-octyl phthalate	8270D	µg/kg dry wt	11	201	58 mg/kg OC	4,500 mg/kg OC	2,067	20
Miscellaneous Extractables								
Dibenzofuran	8270D	µg/kg dry wt	399	443	15 mg/kg OC	58 mg/kg OC	180	20
Hexachlorobutadiene	8270D-SIM	µg/kg dry wt	--	--	3.9 mg/kg OC	6.2 mg/kg OC	11	5
N-Nitrosodiphenylamine	8270D	µg/kg dry wt	--	--	11 mg/kg OC	11 mg/kg OC	28	20
Ionizable Organic Compounds								
Phenol	8270D-SIM	µg/kg dry wt	--	--	420	1,200	140	5
2-Methylphenol	8270D-SIM	µg/kg dry wt	--	--	63	63	63	5
4-Methylphenol	8270D-SIM	µg/kg dry wt	760	2,360	670	670	223	10
2,4-Dimethylphenol	8270D-SIM	µg/kg dry wt	--	--	29	29	29	20
Pentachlorophenol	8270D-SIM	µg/kg dry wt	--	--	360	690	120	50
Benzyl Alcohol	8270D-SIM	µg/kg dry wt	--	--	57	73	57	20
Benzoic Acid	8270D	µg/kg dry wt	2,910	3790	650	650	217	400
PCBs								
Total PCB Aroclors	8082	µg/kg dry wt	62	354	12 mg/kg OC	65 mg/kg OC	6	10

Notes:

- a - 2-Methylnaphthalene is not included in the sum of LPAHs
- b - Washington State Department of Ecology Sediment Sampling and Analysis Plan Appendix, February 2008
- c - TEQs will be calculated using WHO 2005 Mammalian TEFs with ND=DL, EMPC=EMPC & ND=DL/2, EMPC=EMPC
- d - Units designated with "OC" are TOC normalized per SMS guidance; however, TOC values <0.5% or >3% will be not be OC normalized and screened against LAET and 2LAET criteria
- µg/kg = microgram per kilogram
- mg/kg = milligram per kilogram
- HPAH = high-molecular-weight polycyclic aromatic hydrocarbon
- LAET = lowest apparent effects threshold
- 2LAET = second lowest apparent effects threshold
- LPAH = low-molecular-weight polycyclic aromatic hydrocarbon
- PQL = Practical Quantitation Limits
- SSAPA = Sediment Sampling and Analysis Plan Appendix (Washington State Department of Ecology, 2008. *Sediment Sampling and Analysis Plan Appendix* . Ecology Publication No. 03-09-043. February 2008).

Table 2
Quantitative Goals for Sediment Analytical Data

Parameter	Precision (duplicates)	Percent Recovery Goals ¹	Completeness
Sediment			
Grainsize	± 30% RPD	NA	95%
Total solids	± 30% RPD	NA	95%
Total organic carbon	± 30% RPD	75-125% R	95%
Ammonia	± 30% RPD	75-125% R	95%
Sulfide	± 30% RPD	65-135% R	95%
Total metals	± 30% RPD	75-125% R	95%
Volatile organic compounds	± 50% RPD	50-150% R	95%
Semivolatile organic compounds	± 50% RPD	50-150% R	95%
PCBs/Pesticides	± 50% RPD	50-150% R	95%
Surface Water			
Total and dissolved metals	± 25% RPD	75-125% R	95%
PCBs	± 35% RPD	60-140% R	95%
Semivolatile organic compounds	± 35% RPD	60-140% R	95%

Notes:

PCB = polychlorinated biphenyl

R = Recovery

RPD = Relative percent difference

1 Percent recovery goals apply to laboratory control sample (LCS)/laboratory control sample duplicate (LCSD) and matrix spike (MS)/matrix spike duplicate (MSD) analyses

Table 3
Container Requirements, Holding Times, and Preservation Methods

Parameter	Sample Size	Container Size and Type	Holding Time	Sample Preservation Technique
Sediment				
Grain size	300 g	16-oz HDPE	6 months	Cool/4°C (Do Not Freeze)
Total solids	50 g	4-oz Glass	14 days	Cool/4°C
			6 months	Freeze -18°C
Total organic carbon	50 g	from TS container	14 days	Cool/4°C
			6 months	Freeze -18°C
Total sulfides	50 g	2-oz Glass	7 days	5 mL 2N Zn acetate/dark/cool/4°C
Ammonia	40 g	from TS container	7 days	Cool/4°C
Semivolatile organic compounds	150 g	16-oz Glass	14 days until extraction	Cool/4°C
			1 year until extraction	Freeze -18°C
			40 days after extraction	Cool/4°C
Volatile organic compounds	50 g	2-oz Glass	14 days	Cool/4°C; No headspace
Metals	50 g	4-oz Glass	6 months; 28 days for Hg	Cool/4°C
			2 years (except Hg)	Freeze -18°C
PCBs	150 g	from SVOC jar	14 days until extraction	Cool/4°C
			2 years until extraction	Freeze -18°C
			40 days after extraction	Cool/4°C
Archival	--	16-oz Glass	1 year	Freeze -18°C
Water				
Metals, dissolved	100 mL	500 mL HDPE	6 months	HNO ₃ to pH < 2
Mercury, total	100 mL	500 mL HDPE	28 days	HNO ₃ to pH < 3
PCBs	1000 mL	2 x 1000mL Amber Glass	7 days until extraction	Cool/4°C
			40 days after extraction	Cool/4°C
Semivolatile organic compounds	500 mL	2 x 500mL Amber Glass	7 days until extraction	Cool/4°C
			40 days after extraction	Cool/4°C

Notes:

Samples for total sulfides and volatile organic compounds will be collected prior to compositing.

°C = degrees Celsius

mL = milliliter

HDPE = High Density Polyethylene

oz = ounce

PCB = polychlorinated biphenyl

TS = total solid

Table 4
Laboratory Quality Control Sample Analysis Frequency

Analysis Type	Initial Calibration	Ongoing Calibration	Replicates	Matrix Spikes	LCS/SRM^e	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes
Grain size	Each batch ^a	NA	1 per 20 samples	NA	NA	NA	NA	NA
Total solids	Each batch ^b	NA	1 per 20 samples	NA	NA	NA	NA	NA
Total organic carbon	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Ammonia	Each batch ^b	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Total sulfides	Each batch ^b	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
SVOCs	As needed ^c	Every 12 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
VOCs	As needed ^c	Every 12 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
Metals	Daily	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
PCBs/Pesticides	As needed ^c	1 per 10 samples	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample

Notes:

a = Calibration and certification of drying ovens and weighing scales are conducted bi-annually.

b = Initial calibration verification and calibration blank must be analyzed at the beginning of each batch.

c = Initial calibrations are considered valid until the ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed.

d = Isotope dilution method- labeled standards are spiked in every dioxin/ furan sample to assess method performance in the sample matrix.

e = The Puget Sound Sediment Reference Material will be used for PCB analysis of sediment samples.

NA = Not applicable

LCS = Laboratory control sample

OPR = Ongoing Precision and Recovery sample (used for dioxin/furan analysis)

Table 5
Water Sampling Parameters and Analytical Methods

Parameter	Analytical Method	Units	Laboratory PQL	National Recommended Water Quality Criteria Aquatic Life Criteria ¹	
				Acute Criteria	Chronic Criteria
Metals ²					
Arsenic	6020A/200.8	µg/L	0.5	--	--
Cadmium	6020A/200.8	µg/L	0.10	40	8.8
Chromium ³	6020A/200.8	µg/L	0.50	1100	50
Copper	6020A/200.8	µg/L	0.5	4.8	3.1
Lead	6020A/200.8	µg/L	0.1	210	8.1
Mercury	7470A	µg/L	0.1	1.8	0.94
Silver	6020A/200.8	µg/L	0.2	1.9	1.9 ^b
Zinc	6020A/200.8	µg/L	4.0	90	81
SVOCs					
Polycyclic Aromatic Hydrocarbons (PAHs)					
Total LPAH	8270D	µg/L	--	--	--
Naphthalene	8270D	µg/L	1.0	--	--
Acenaphthylene	8270D	µg/L	1.0	--	--
Acenaphthene	8270D	µg/L	1.0	--	--
Fluorene	8270D	µg/L	1.0	--	--
Phenanthrene	8270D	µg/L	1.0	--	--
Anthracene	8270D	µg/L	1.0	--	--
2-Methylnaphthalene ^d	8270D	µg/L	1.0	--	--
Total HPAHs	8270D	µg/L	--	--	--
Fluoranthene	8270D	µg/L	1.0	--	--
Pyrene	8270D	µg/L	1.0	--	--
Benzo(a)anthracene	8270D	µg/L	1.0	--	--
Chrysene	8270D	µg/L	1.0	--	--
Total benzo(b+k)fluoranthenes	8270D	µg/L	5.0	--	--
Benzo(a)pyrene	8270D	µg/L	1.0	--	--
Indeno(1,2,3-cd)pyrene	8270D	µg/L	1.0	--	--
Dibenz(a,h)anthracene	8270D	µg/L	1.0	--	--
Benzo(g,h,i)perylene	8270D	µg/L	1.0	--	--
Chlorinated Benzenes					
1,2-Dichlorobenzene	8270D	µg/L	1.0	--	--
1,4-Dichlorobenzene	8270D	µg/L	1.0	--	--
1,2,4-Trichlorobenzene	8270D	µg/L	1.0	--	--
Hexachlorobenzene	8270D	µg/L	1.0	--	--
Phthalates					
Dimethyl phthalate	8270D	µg/L	1.0	--	--
Diethyl phthalate	8270D	µg/L	1.0	--	--
Di-n-butyl phthalate	8270D	µg/L	1.0	--	--
Butyl benzyl phthalate	8270D	µg/L	1.0	--	--
Bis(2-ethylhexyl) phthalate	8270D	µg/L	3.0	--	--
Di-n-octyl phthalate	8270D	µg/L	1.0		
Miscellaneous Extractables					
Dibenzofuran	8270D	µg/L	1.0	--	--
Hexachlorobutadiene	8270D	µg/L	3.0	--	--
N-Nitrosodiphenylamine	8270D	µg/L	1.0	--	--
Ionizable Organic Compounds					
Phenol	8270D	µg/L	1.0	--	--
2-Methylphenol	8270D	µg/L	1.0	--	--
4-Methylphenol	8270D	µg/L	2.0	--	--
2,4-Dimethylphenol	8270D	µg/L	3.0	--	--
Pentachlorophenol	8270D	µg/L	10.0	--	--
Benzyl Alcohol	8270D	µg/L	2.0	--	--
Benzoic Acid	8270D	µg/L	20	--	--

Table 5
Water Sampling Parameters and Analytical Methods

Parameter	Analytical Method	Units	Laboratory PQL	National Recommended Water Quality Criteria Aquatic Life Criteria ¹	
				Acute Criteria	Chronic Criteria
Polychlorinated Biphenyls (PCBs)					
Total PCB Aroclors ⁴	8082B	µg/L	0.01	10 ⁵	0.03

Notes:

a = 2-Methylnaphthalene is not included in the sum of LPAHs

µg/L = micrograms per liter

HPAH = high-molecular-weight polycyclic aromatic hydrocarbon

LPAH = low-molecular-weight polycyclic aromatic hydrocarbon

PCBs = Polychlorinated Biphenyls

PQL = Practicle Quantitation Limit

National Recommended Water Quality: Aquatic Life Criteria,

1 <http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm>

Acute and chronic criteria for metals (except mercury) are based on the dissolved fraction. The chronic criterion for mercury is based

2 on total recoverable and the acute criterion is based on the dissolved fraction.

Acute and chronic criteria for chromium is for the hexavalent form. Hexavalent chromium is not one of the chemicals of concern at the Jorgensen Forge site; therefore chromium will be reported.

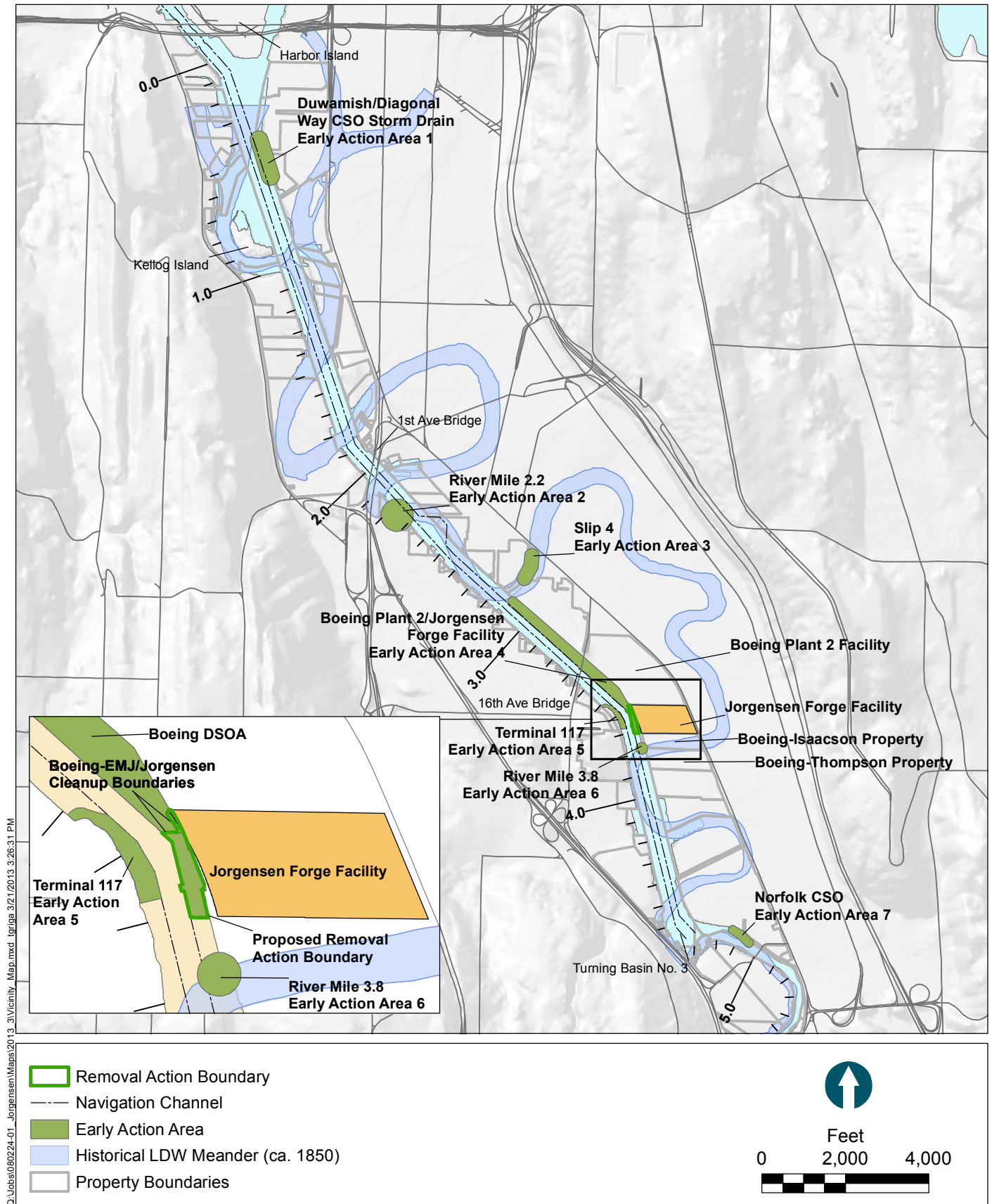
4 Criteria for total PCBs based on the total recoverable fraction (EPA 2002)

There is no National Recommended Water Quality Aquatic Life Acute Criterion for PCBs the Washington State Acute Marine Criterion

5 for PCBs (WAC 173-201A-240) is used.

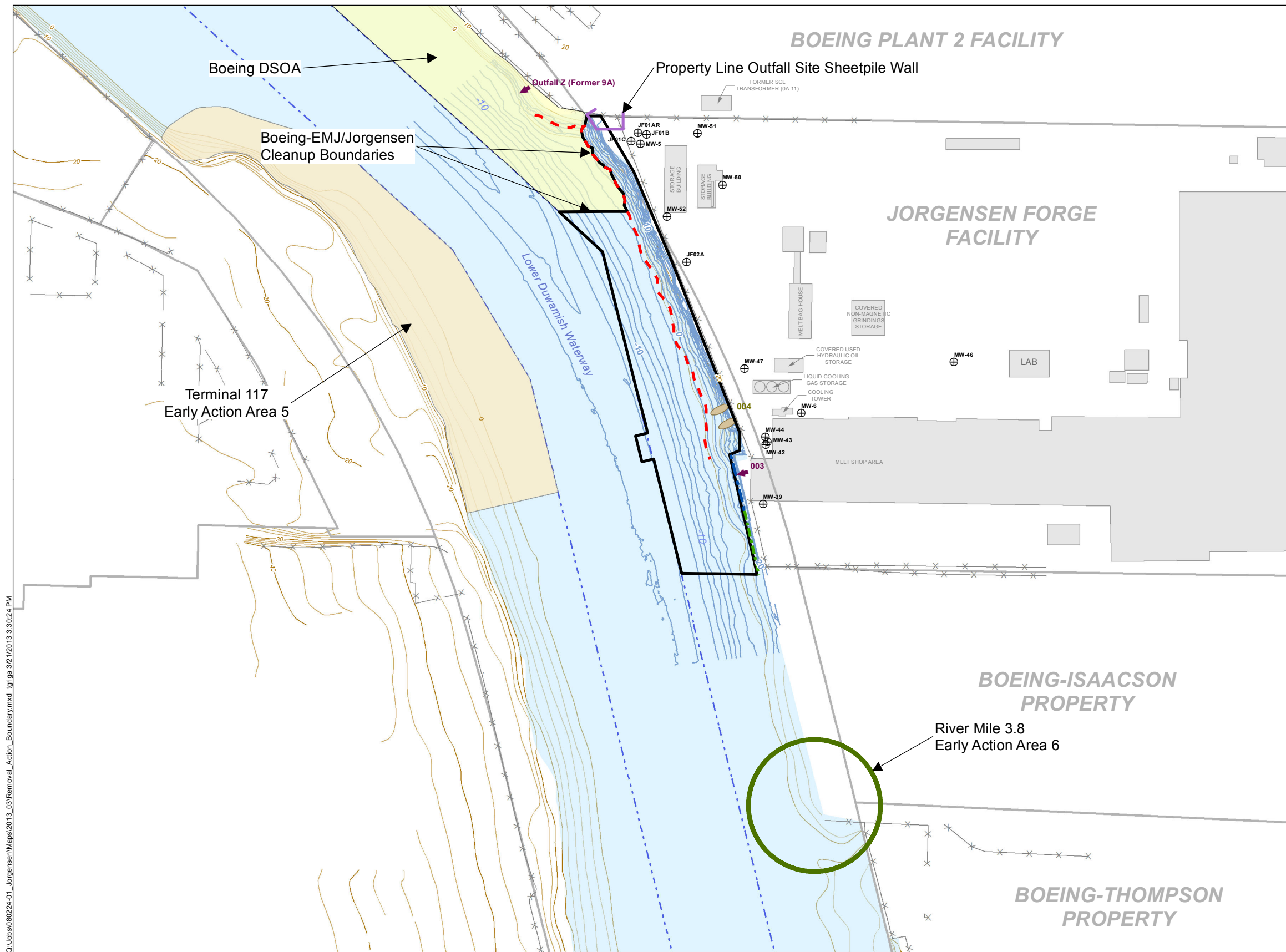
6 There is no chronic criterion for silver; the acute criterion of 1 .9 ug/L will be used as the chronic criterion/reporting limit.

FIGURES



Q:\Jobs\080224-01_Jorgensen\Maps\2013_3\Vicinity_Map.mxd tgriga 3/21/2013 3:26:31 PM

Q:\Jobs\080224-01_Jorgensen\Maps\2013_03\Removal_Action_Boundary.mxd 3/21/2013 3:30:24 PM

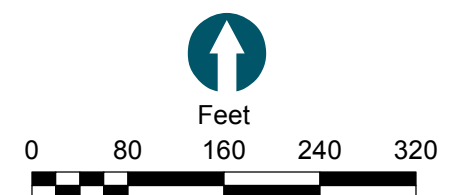


LEGEND

- ⊕ Groundwater Monitoring Well
- Active Outfall
- - - Toe of Existing Riprap
- - - Existing Sheetpile Wall
- - - Existing Concrete Panel Wall
- × Fences
- - - Federal Navigation Channel
- ▭ Removal Action Boundary
- Debris Pile
- ▭ Property Boundaries
- Boeing DSOA
- Terminal 117 Early Action Area 5 Boundary
- ▭ Property Line Outfall Site Sheetpile Wall

NOTES:

1. Bathymetric survey by eTrac dated February 8, 2012. Additional back survey by AEC Consultants, Inc. dated February 21, 2012. Bathymetric and bank survey merged with upland survey by PLS, Inc. dated January 24, 2012.
2. Outfall locations field identified on May 14, 2003.
3. The toe of riprap slope was surveyed during a low tide on August 28, 2008.
4. The Boeing-EMJ/Jorgensen cleanup boundaries is identified in the Memorandum of Understanding between Boeing and EMJ/Jorgensen Forge, dated August 2007 (EMJ et al. 2007).



ATTACHMENT 2

FIELD SAMPLING PLAN

ATTACHMENT 2

FIELD SAMPLING PLAN

SAMPLING AND ANALYSIS PLAN

JORGENSEN FORGE EARLY ACTION AREA

Prepared for

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On behalf of

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March 2013 2012

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degree Celsius
AOC	Administrative Settlement Agreement and Order on Consent for Removal Action Implementation
BODR	Basis of Design Report
Boeing	The Boeing Company
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
COC	chain-of-custody
CQAP	Construction Quality Assurance Plan
DGPS	Differential Global Positioning System
DSOA	Duwamish Sediment Other Area
EAA	Early Action Area
EMJ	Earle M. Jorgensen Company
EPA	U.S. Environmental Protection Agency
Facility	Jorgensen Forge facility
FSP	Field Sampling Plan
HASP	Health and Safety Plan
Jorgensen Forge	Jorgensen Forge Corporation
LDW	Lower Duwamish Waterway
NAD83	North American Datum 83
NTCRA	non-time critical removal action
OMMP	Operations, Monitoring, and Maintenance Plan
MLLW	mean lower low water
MOU	Memorandum of Understanding
PCB	polychlorinated biphenyl
PPE	personal protective equipment
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control

RAB	removal action boundary
RvAL	removal action level
SAP	Sampling and Analysis Plan
SOW	Statement of Work
WQMP	Water Quality Monitoring Plan

1 INTRODUCTION AND SCOPE OF DOCUMENT

This Field Sampling Plan (FSP) was prepared on behalf of Earle M. Jorgensen (EMJ) and Jorgensen Forge Corporation (Jorgensen Forge) pursuant to the Administrative Settlement Agreement and Order on Consent for Removal Action Implementation (AOC) issued by the U.S. Environmental Protection Agency (EPA) Region 10 (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Docket No. 10-2013-0032) and attached Statement of Work (SOW). This FSP is Attachment 2 to the Sampling and Analysis Plan (SAP), which is an appendix to the Basis of Design Report (BODR) Final Design submittal for the cleanup of contaminated sediments and associated bank soils in a portion of the Lower Duwamish Waterway (LDW) Superfund Site adjacent to the Jorgensen Forge facility (Facility) located in Tukwila, King County, Washington (see Figure 1 of the BODR; Jorgensen Forge Early Action Area [EAA]). The cleanup will be conducted as a non-time critical removal action (NTCRA) in accordance with EPA's selected cleanup alternative documented in the *Action Memorandum for a Non-Time Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington* (EPA 2011) and detailed in the *Final Engineering Evaluation/Cost Analysis – Jorgensen Forge Facility, 8531 East Marginal Way South, Seattle, Washington* (Anchor QEA 2011). The southern portion of the Jorgensen Forge EAA is located near River Miles 3.6 to 3.7 on the east bank of the LDW, as shown on Figure 1.

The limits of the Jorgensen Forge EAA (herein referred to as the removal action boundary [RAB]) are shown on Figure 2. The RAB extends from the top of the bank at approximately +19 to +20 feet mean lower low water (MLLW; or top of the sheetpile/concrete panel on the southern portion of the Facility) to the federal navigation channel. The RAB is bounded to the north by The Boeing Company (Boeing) Plant 2 Duwamish Sediment Other Area (DSOA) and Southwest Bank Corrective Measure EAA cleanup area, as specified in the EPA-approved Memorandum of Understanding (MOU; EMJ et al. 2007). EPA identified this cleanup area as the northern portion of the Jorgensen Forge EAA.

This FSP addresses the collection of data required during the construction phase of the removal action. Data will be used for verification and documentation purposes during the construction phase of the removal action as well as for the completion of the long-term

monitoring performed in accordance with the Construction Quality Assurance Plan (CQAP; Appendix D of the BODR), Water Quality Monitoring Plan (WQMP; Appendix E to the BODR), and Operations, Monitoring, and Maintenance Plan (OMMP; Appendix F to the BODR).

The removal action consists of the following elements:

- **Sediment Dredging.** Removal of sediments exceeding the identified polychlorinated biphenyl (PCB) removal action level (RvAL; EPA 2008).
- **Sediment Backfilling.** Placement of imported clean fill material in removal areas to reach approximately the existing grade and elevation.
- **Shoreline Bank Reconfiguration.** Excavation of shoreline bank debris and sediments/soils to support greater slope stability and containment of the shoreline bank; this work is planned to be conducted in-the-dry to the extent possible based on tidal elevations encountered during completion of the removal action.

This FSP addresses the following:

- Visual monitoring of the shoreline bank and backfill areas
- Surface water and sediment sampling
- Subsurface sediment and soil sampling Decontamination procedures
- Sample identification procedures
- Sample collection schedule
- Sampling documentation, sample handling, and chain-of-custody (COC) procedures
- Quality assurance and quality control (QA/QC) requirements
- Waste management

2 VISUAL MONITORING

This section describes the visual monitoring activities as they pertain to the OMMP (Appendix F to the BODR). Visual monitoring of the backfill and reconfigured shoreline area will be conducted during the long-term monitoring period (see OMMP). The remainder of this section provides information that is consistent for all visual monitoring methods, including the equipment list, and visual monitoring procedure.

2.1 Equipment List

The following general equipment will be required during sample collection and visual monitoring activities:

- Personal protective equipment (PPE), as required by the Health and Safety Plan (HASP; Attachment 1 of the SAP)
- Navigation and site maps
- Camera
- Field notebook
- Measuring tape (300 feet long)

2.2 Visual Monitoring Procedure

Visual monitoring of the backfill and reconfigured shoreline area will be performed in-the-dry from land at low tide. The visual monitoring approach is described in detail in the OMMP (Appendix F to the BODR). Photographs and observation notes will be taken during each monitoring event. Areas of instability or sloughing will be documented as described in Section 4.1.2.4.

2.3 Visual Monitoring Schedule

The schedule of visual monitoring events is identified in the OMMP (Appendix F to the BODR).

3 SURFACE WATER, SEDIMENT AND SOIL MONITORING

This section describes the sample collection activities as they pertain to the Construction Quality Assurance Plan (CQAP; Appendix D of the BODR) OMMP (Appendix F to the BODR) and WQMP (Appendix E to the BODR).

Surface water sampling will be conducted as described in the WQMP (Appendix E to the BODR) during the construction phase to minimize adverse impacts to water quality. Surface water chemistry grab samples will be collected using a van Dorn bottle or similar device. Water quality field parameter measurement activities are described in detail in the WQMP and are not included in this FSP.

Surface sediment sampling will be conducted to assess the condition of on-site and adjacent surface sediments prior to and immediately following construction (see the CQAP) and during the 10-year long-term monitoring period (see the OMMP). Post-dredge subsurface sediment sampling will also be conducted to document the final post-dredge surface (z layer) chemical concentrations are not significantly greater (as defined in CQAP; area weighted concentrations in the RAB are greater than 20 times the RvAL or 240 milligrams per kilogram normalized for organic carbon) than the total PCB RvAL. Finally, post-excavation bank soil sampling will be conducted to document the nature of the material beneath the shoreline backfill area.

3.1 Sample Collection

This section provides information that is consistent for all sampling methods, including station positioning and the equipment list. Additional subsections provide method-specific collection and processing procedures.

3.1.1 Station Positioning

The objective of location control is to accurately determine horizontal and vertical positioning of sampling locations. To achieve this objective, each sampling location will be referenced to known survey control points using the methods described below.

The following parameters will be documented at each sampling location, if applicable:

- Location coordinates (Washington state plane north zone, North American Datum 1983 [NAD83], international survey feet)
- Vertical elevation in feet National Geodetic Vertical Datum (MLLW, including mudline and tidal elevation above mudline)
- Actual water depth
- Distance from “construction work area” (applies to water quality monitoring only)
- Time and date
- Tidal elevation referenced to MLLW

These parameters will be measured using pre-surveyed, visual horizontal triangulation to known control points and/or landmarks on shore if necessary, a differential global positioning system (DGPS), laser range finder, and weighted tape measures.

3.1.1.1 Differential Global Positioning System

Location control will be performed with a DGPS unit onboard the sampling vessel. DGPS coordinates for each sampling location will be recorded at the time of sampling.

3.1.1.2 Visual Horizontal Triangulation Methods

Visual horizontal triangulation methods will be used as a backup method to the DGPS. This system will use pre-surveyed markers and/or established landmarks on shore. This method determines sampling locations based on horizontal distances to survey control points and/or landmarks identifiable on base maps. Locations will be identified by measuring the horizontal distance from the actual sampling location to the known control point or landmark to the nearest foot using a tape measure. Horizontal measurements can be calculated from registered base maps in order for field measurements can be translated to state plane coordinates. Buoy markers may be used to mark the sampling location.

3.1.1.3 Vertical Control

The vertical control parameters measured will be depth to sediment (mudline) and tidal elevation. The depth to sediment will be measured during each sampling event using a hand-held weighted tape (lead line). The tape will be dropped from the work platform to

the bottom, pulled taut, and read to the nearest 0.1 foot. This observation will be cross-checked against the onboard depth sounder.

Tidal readings will be taken periodically from a tide board installed on site and checked against daily tide charts for the LDW. Tidal elevations and time will be monitored and recorded before each sample is collected to the nearest 0.1 foot. Sample elevations will then be corrected to MLLW.

3.1.2 Equipment List

The following general equipment will be required during sample collection procedures:

- PPE, as required by the HASP (Attachment 1 of the SAP)
- Navigation and site maps
- Camera
- Field notebook
- Aluminum decked boat equipped with outboard motor
- Calibrated rod or ruler for sediment depth measurement
- Sampling device (Van Veen grab sampler or similar device, MudMole or similar device and van Dorn or similar device)
- Weighted tape measure calibrated in 0.1-foot increments
- Decontamination supplies
- Stainless-steel sample processing equipment (e.g., bowls, spoons)

3.2 Surface Water Sample Collection

Water column samples will be collected at the depth (3 feet from surface, or 4 feet from bottom) with the highest turbidity as determined by field parameter measurements. Samples will be collected from a self-propelled vessel. Water chemistry grab samples will be collected using a decontaminated van Dorn bottle or similar device and will be analyzed for dissolved metals and total PCB Aroclors. Recovered water from the appropriate depth will be transferred immediately to appropriate laboratory-provided, pre-labeled, pre-cleaned sample containers.

3.3 Surface Sediment Sample Collection

Surface sediment samples from the 0- to 10-centimeter (cm) biologically active zone will be collected from a vessel for chemical testing using a Van Veen grab sampler or equivalent, in accordance with the protocol listed below.

3.3.1.1 Van Veen Sampling Procedure

The sampling vessel will be maneuvered to the target sampling location. Once the targeted area is determined to be suitable for grab sample collection, the Van Veen jaw assembly will be decontaminated.

The sampler will be deployed vertically through the water column until the river bottom is reached. The winch cable to the grab sampler will be drawn taut and vertical. The location of the cable hoist will be measured and recorded by the location control personnel. The jaw assembly will be closed to collect the sediment sample to a penetration depth of approximately 15 cm. The apparatus will be pulled upward out of the river bottom using a winch and raised to the surface.

The sediment sample will be retrieved aboard the vessel and evaluated against the following acceptability criteria:

- Grab sampler is not overfilled (i.e., sediment surface is not against the top of sampler).
- Sediment surface is relatively flat, indicating minimal disturbance or winnowing.
- Overlying water is present, indicating minimal leakage.
- Overlying water has low turbidity, indicating minimal sample disturbance.
- Desired penetration depth (i.e., 10 cm) is achieved.

Overlying water will be siphoned off and a decontaminated stainless-steel trowel or similar device will be used to collect the sediment from inside the sampler, taking care not to collect sediment in contact with the sides/surface of the sampler.

In the event that gravel, armor rock, or other debris prevents the jaw assembly from closing, the sampling station will be moved 5 feet and a subsequent grab sample collection will be attempted. In areas where armor rock has been placed as part of the shoreline bank

containment, collection of surface grab samples may not be possible. If sample collection is unsuccessful after three attempts, the station will be excluded from the analysis.

3.3.2 Processing Procedure

Prior to sample collection from the grab sampler, an aliquot for sulfides analysis will be collected from the 0- to 10-cm interval and placed directly into the sample container without homogenization. Following sulfide analysis, additional sediment will be collected from the 0- to 10-cm interval and placed in a decontaminated stainless-steel mixing container and homogenized using a stainless-steel spoon or an electric drill with decontaminated stirring paddle until the sediment is of uniform color and consistency. Once homogenized, the subsamples will be placed in appropriate pre-labeled containers. Aliquots will also be collected and archived for potential future additional analyses. Samples will be submitted for laboratory analysis following appropriate handling and COC requirements. A complete description of analytes, analytical methods, target detection limits, and holding requirements can be found in Table 1 of the Quality Assurance Project Plan (QAPP; Attachment 1 to the SAP).

3.4 Subsurface Sediment Sample Collection

Subsurface sediment samples from the 0- to 1-foot interval below the final dredge elevation will be collected from a vessel for chemical testing using a MudMole core sampler or equivalent, in accordance with the protocol listed below. Additional material below the sample interval may be archived to support future potential data needs.

3.4.1 MudMole Sampling Procedure

The sampling vessel will be maneuvered to the target sampling location. The bottom of the coring device will be outfitted with a core catcher to maximize core recovery following penetration. The corer will use a decontaminated aluminum barrel for collecting the sediment. Core tube caps will be removed immediately prior to placement into the coring device.

The corer will be deployed by winch and sent to the river bottom, where the unit will then be energized and lowered to the target coring depth. When that depth is reached, the corer

will be turned off and returned to the surface for sample processing. During the coring operation, the penetration of the core barrel will be continuously monitored. Section 3.6 describes the field decontamination procedures for core collection.

The target penetration depth for each core is a minimum of 3 feet below the final dredge elevation. Core penetration and recovery will be assessed via internal and external sensors on the MudMole. The core will be sealed on the top to create suction and then removed from the sediment slowly and steadily to avoid agitating the sample. Divers will then transfer the core to the topside crew for processing. Care will be taken to minimize disturbance during this transfer. Once on the vessel, each core will be inspected and a physical description of the material at the mouth of the core will be entered on the core log. The location of the cable hoist will be measured and recorded by the location control personnel.

3.4.1.1 Sample Acceptance Criteria

The sediment core acceptance criteria are as follows:

- The core penetrated to (and retained material to) the target depth or refusal.
- Recovery was at least 75 percent of the length of core penetration.
- Sediment does not extend out of the top of the core tube or contact any part of the sampling apparatus at the top of the core tube.
- There are no obstructions in the cored material that might have blocked the subsequent entry of sediment into the core tube and resulted in incomplete core collection.
- There are no significant air gaps in the core tube, or evidence of significant loss of material out of the cutter head during retrieval.

If acceptance criteria are not achieved, the core will be rejected and the sample station will be moved 5 feet and a subsequent core will be attempted. If sample acceptance criteria are not met after three attempts, the location will be excluded from sample collection. Following inspection, core processing will be conducted as described in Section 3.4.2.

3.4.2 Core Processing Procedure

Core tubes will be cut vertically using a circular saw or similar device, taking care not to penetrate the sediment too deeply while cutting. Each core will be described and documented on standardized core log. Core logs will include the following observations, as relevant:

- Sample recovery (recovered sediment depth relative to penetration depth) and calculated percent compaction
- Physical soil description in accordance with the Unified Soil Classification System (soil type, density, color, etc.)
- Odor (hydrogen sulfide, petroleum, etc.)
- Presence of vegetation
- Presence of man-made debris (e.g., trash)
- Depth and distinctness of geologic contacts
- Any other distinguishing characteristics or features

All cores will be processed in a stepwise fashion, as follows:

- **Photograph Core.** Field personnel will take digital photographs of the entire penetration depth of the core with measuring tape corresponding to the depth below mudline.
- **Core Logging.** Field personnel will record the description of the full length of the core sample on the core log.
- **Identify Sampling Zones.** The bottom of the dredge elevation will be identified in each core. The sample interval will be established between 0 and 1 feet below the final dredge elevation.

Following identification of sampling zones, sediment will be collected from the 0- to 1-foot interval below the final dredge elevation, placed in a decontaminated stainless-steel mixing container, and homogenized using a stainless-steel spoon or an electric drill with decontaminated stirring paddle until the sediment is of uniform color and consistency. Once homogenized, the subsamples will be placed in appropriate pre-labeled containers. The samples will be submitted for laboratory analysis following appropriate handling and COC requirements as described in the QAPP (Attachment 1 to the SAP). A complete description

of analytes, analytical methods, target detection limits, and holding requirements are also provided in the QAPP.

3.5 Shoreline Bank Soil Sample Collection

Surface soil samples from the 0- to 1-foot interval will be collected from the landside for chemical testing by hand or excavator bucket, in accordance with the protocol listed below.

3.5.1.1 Soil Sampling Procedure

The sampling personnel or excavator will maneuver to the target sampling location. Using a decontaminated stainless steel shovel or an excavator with a decontaminated bucket, a pit will be dug to a minimum of 1-foot below the final excavation elevation. Using a decontaminated stainless steel shovel or spoon, soil will be collected from the sidewall of the pit between 0 and 1 feet below the final excavation elevation and placed in a decontaminated stainless-steel mixing container. Prior to sample collection, care will be taken to remove any soil from the sidewall that may have been smeared from higher elevations during excavation of the pit.

3.5.1.2 Processing Procedure

The collected soil will be placed in a decontaminated stainless-steel mixing container and homogenized using a stainless-steel spoon or an electric drill with decontaminated stirring paddle until the soil is of uniform color and consistency.

Each sample will be described and documented on standardized sample collection log. Collection logs will include the following observations, as relevant:

- Physical soil description in accordance with the Unified Soil Classification System (e.g., soil type, density, color.)
- Odor (e.g., hydrogen sulfide, petroleum)
- Presence of vegetation
- Presence of man-made debris (e.g., trash)
- Depth and distinctness of geologic contacts
- Any other distinguishing characteristics or features

Field personnel will take digital photographs of the sample pit and homogenized sample. Once homogenized, the samples will be placed in appropriate pre-labeled containers. The samples will be submitted for laboratory analysis following appropriate handling and COC requirements as described in the QAPP (Attachment 1 to the SAP). A complete description of analytes, analytical methods, target detection limits, and holding requirements are also provided in the QAPP.

3.6 Decontamination Procedures

Sample containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with collected samples must meet high standards of cleanliness. All equipment that comes into contact with sampling media will be decontaminated prior to each day's use and between sampling locations. The decontamination procedure is as follows:

- Pre-wash rinse with site water
- Wash with solution of laboratory grade non-phosphate based soap
- Rinse with site water
- Rinse three times with laboratory-grade distilled water
- Store in clean, closed container or wrap in aluminum foil for next use

Additionally, the laboratory will provide pre-cleaned and labeled sample containers.

3.7 Sample Identification Numbers

3.7.1 Surface Water

All surface water samples will be properly identified on their attached labels as well as on any forms or in other documentation. Station names will use the following identification scheme consisting of up to 12 alphanumeric characters (A-BBBB-C-YYMMDD):

1. The first character (A) will be used to identify the construction activity being monitored:
 - R = Removal (e.g., Dredging, debris removal, pile removal)
 - B = Backfilling

2. The next two characters (BB) will be used to identify the water quality monitoring location:
 - BG = Background Station
 - EW = Early Warning Station
 - 150C = 150-foot Compliance Station (downstream or upstream of the “construction work area”)
 - 200M = 200-foot Monitoring Station (downstream or upstream of the “construction work area”)
 - 250M = 250-foot Monitoring Station (downstream or upstream of the “construction work area”)
 - 300C = 300-foot Compliance (downstream or upstream of the “construction work area”)
3. The third character (C) will be used to identify the monitoring depth:
 - S = Surface
 - M = Middle
 - B = Bottom
4. The last six characters (YYMMDD) will be used to identify the monitoring date:
 - YY = The last two digits of the year of collection
 - MM = The month of collection
 - DD = The date of collection

For example, following this identification scheme, “R-150C-B-131018” represents a sample collected during monitoring during removal (R) at the 150-foot compliance station (150C) at the bottom depth in the water column (B) on October 18, 2013.

3.7.2 Soil and Sediment

All soil and sediment samples will be properly identified on their attached labels as well as on any forms or in other documentation. All sample identification numbers will be consistent with the following identification scheme:

- The first two characters will be “JF” to identify the samples as Jorgensen Forge samples.

- The next characters will be used for station identification as identified in Table 2 of the OMMP (Appendix F of the BODR) and CQAP (Appendix D of the BODR).
- The last six characters will indicate the sample date by YYMMDD.

For example, following this identification scheme, JF-PEB-1-120518 indicates a sample collected at Jorgensen Forge at Station PEB-1 on May 18, 2012.

3.7.3 Sample Collection Schedule

The schedule of sample collection events is identified in the CQAP (Appendix D to the BODR), WQMP (Appendix E to the BODR), and OMMP (Appendix F to the BODR).

4 DOCUMENTATION, SAMPLE HANDLING, AND CHAIN-OF-CUSTODY

Requirements for documentation, sample handling, and COC procedures related to sample collection events are outlined in this section.

4.1 Documentation

Field activities and samples must be properly documented during the sample collection process. Documentation of field activities provides an accurate and comprehensive record of the work performed sufficient for a technical peer to reconstruct the day's activities and provide certification that all necessary requirements were met. General requirements include:

- Use of a Field Activity Log to formally document activities and events. The Field Activity Log can be a standard or project-specific form or a bound field book. Pre-printed standard forms are available for many activities and should be used whenever possible. These forms provide prompts and request additional information that may be useful and/or needed. Project-specific field forms may be generated or existing forms may be modified to meet specific project needs. As required, client-supplied forms may be substituted.
- Appropriate header information documented on each page, including project title, project number, date, weather conditions, changes in weather conditions, other persons (if any) in the field party, and author. The specific information requested depends on the nature of the work being performed and on the form being used. Information fields that are not applicable should be noted "N/A" or with other appropriate notations.
- Field documentation entries using indelible ink.
- Legible data entries. A single line should be drawn through incorrect entries and the corrected entry should be written next to the original strikeout. Strikeouts are to be initialed and dated by the originator.
- Applicable units of measurement with entry values.
- Field records maintained in project files unless otherwise specified by a client or stipulated by a contract.

4.1.1 Documentation Entries

A chronology of field events will be recorded. General entry requirements include:

- Visitors to the removal action area, including EMJ, Jorgensen Forge, and regulatory agency representatives
- Summary of pertinent project communications with the client, regulators, or other removal action area visitors
- Other contractors working at the removal action area
- A description of the day's field activities, in chronological sequence using military time notation (e.g., 9:00 am: 0900 and 5:00 pm: 1700)
- If applicable, calibration of measuring and test equipment and identification of the calibration standard(s) and use of a Calibration Log, if available, with cross-reference entered into the field book
- Field equipment identification, including type, manufacturer, model number, or other specific information
- General weather conditions, including temperature, wind speed, and direction readings, such as time of measurement and units
- Safety and/or monitoring equipment readings, including time of measurements and units
- If applicable, reference in the field notebook to specific forms used for collection of data
- Subcontractor progress and/or problems encountered
- Changes in the scope of work
- Other unusual events

4.1.2 Specific Requirements

4.1.2.1 Sample Collection

Sample collection data will be documented in a bound field book and/or on a sample collection form. Where both are being used, information contained in one is cross-referenced to the other. Entries may include:

- Sample identification number, location taken, depth interval, sample media, sample preservative, collection time, and date
- Sample collection method and protocol

- Physical description of the sample (according to the Unified Soil Classification System)
- QC-related samples collected (e.g., duplicates, blinds, trip blanks, field blanks)
- Container description and sample volume
- Pertinent technical data, such as sample penetration depth and sampling interval
- Pertinent technical comments
- Identification of personnel collecting the sample

4.1.2.2 Sample Labeling

Sample labels must be prepared and attached to sample containers. Labels will either be provided by the laboratory performing the analyses or will be generated internally. The information to be provided includes:

- Sample identification number
- Sample date and collection time
- Physical description of the sample (e.g., water, solid, gas)
- Analytical parameters
- Preservatives, if present
- Sampling location
- Client

4.1.2.3 Visual Monitoring Documentation

Color photographs of a reasonable quality and quantity will be taken to document any evidence of sloughing or instability in the backfill material or reconfigured shoreline. A visual observation log will be completed in the field by the monitoring crew (Attachment 2). Any areas of sloughing or instability will also be marked on a site map (Attachment 3).

4.1.2.4 Surface Water Collection

Specific surface water sample collection documentation procedures are described in detail in the WQMP (Appendix E to the BODR) and are not included in this FSP.

4.1.2.5 *Sediment and Soil Collection*

The field logbook will include clear information concerning sediment and soil collection activities. Sediment Core Collection Log and Visual Observation Log (Attachments 1 and 2) will be completed for each sediment and soil grab or core. In addition to standard entries of personnel, date, and time, the log will also include information regarding station coordinates, penetration of the sampler, sample recovery length and percentage, and physical characteristics of the sediment (such as texture, color, odor, stratification, and sheens).

4.2 Sample Handling Procedures

Sample handling procedures include correctly labeling and packing all sample containers prior to transport for laboratory testing. Sample containers will be obtained from the analytical laboratory. Each container will be labeled appropriately with all relevant information as detailed in Section 4.1.2.2.

Samples will be stored and shipped in a properly packed container at 4 degrees Celsius (°C). All samples will be delivered to the laboratory within 48 hours of the time of collection, with the possible exception of some samples collected on Friday or Saturday. In those cases, the samples will be stored at 4°C and shipped at the earliest allowable time.

4.3 Chain-of-Custody Procedures

An important component of data collection is the ability to demonstrate that samples were obtained from the stated locations and that they reached the laboratory or archive location without alteration. Evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal or archive must be properly documented. Documentation will be accomplished through a COC form that documents each sample and identifies the individuals responsible for sample collection, shipment, and receipt. A sample is considered in one's custody if at least one of the following criteria is met:

- The sample is in a person's actual possession.
- The sample is in unobstructed view, after being in the person's actual possession.
- The sample is locked and only accessible by the custodian after having been in the person's actual possession.
- The sample is in a secured area, restricted to authorized personnel (e.g., laboratory).

A laboratory typically will not accept samples for analysis without a correctly prepared COC form. The COC form must be signed by each individual who has the sample in his/her custody. A COC form is to be prepared for each sample shipped to a laboratory for analysis. Information on this form correlates with other supporting documentation, including sample labels and sample collection logs.

The COC form accounts for the elapsed time and custodians of the sample from the time of its collection. The individuals who have physically handled the sample or witnessed initial sample collection and packaging (e.g., a sample team member) must be identified on the form. A sample team member relinquishes the sample by signing the COC form. Individuals who either relinquish or receive samples must include their complete names, company affiliation, and the date and time the samples were relinquished and received. The times that the samples are relinquished and received by the next custodian should coincide, with the exception of transfer by commercial carriers. Commercial carriers will not be required to sign the COC.

If a sample is to be stored for a period of time (e.g., overnight), measures are to be taken to secure the sample container in a manner that provides only the custodian of record with access. If samples are relinquished to a commercial carrier (e.g., UPS, Federal Express), the carrier waybill number will be recorded and a copy of the waybill will be attached to the COC form. These documents are maintained with other field documentation. The original COC will be sealed inside the shipping container with the samples.

If a correction is made to the COC, the correction should be made by the originator of the change, who will draw a single line through the error, initial and date the correction, and, if necessary, provide an explanation of the change. The documentation should have sufficient detail to clearly document the change to a third-party reviewer.

5 QUALITY ASSURANCE AND QUALITY CONTROL REQUIREMENTS

All analyses described in this FSP will be conducted in accordance with the standard QA/QC procedures described in the QAPP (Attachment 1 of the SAP). Analytical instruments will be maintained and calibrated regularly. Log books will be maintained for major field and laboratory instrumentation to document servicing, maintenance, and instrument modification.

5.1 Analytical Chemistry

Quality procedures are described for each analytical method in the QAPP (Attachment 1 of the SAP). The type and frequency of QA/QC samples analyzed by the laboratory will be according to the specified analytical method. Necessary corrective actions will be taken to address problems, according to the guidelines for a particular method. All corrective actions will be reported, along with any deviations from the standard protocols.

Results of all laboratory QA/QC analyses and anything that might affect the integrity of the results will be reported. Any deviations from the standard testing guidelines, QA/QC limits, and acceptability criteria will be reported, including a discussion of their effect on data validity. All datasheets will be checked to ensure that test conditions are within the protocol specifications, and project data will be reviewed to determine their usability for making suitability determinations.

6 WASTE MANAGEMENT

Procedures that will be used to properly dispose of field-generated waste from the field work associated with sediment samples. Waste disposal will fall into two categories:

- Sediment spilled on the vessel deck during surface sample collection and sediment from rejected grab or core samples will be washed into the surface water at the collection site.
- Waste in the category of disposable sampling materials and PPE will be placed in heavy-weight garbage bags or other appropriate containers.

All disposable sampling materials and PPE used in sample processing (such as disposable coveralls, gloves, and tubing) will be placed in heavyweight garbage bags or other appropriate containers. Disposable materials will be placed in an on-site refuse container for disposal at a solid waste landfill.

7 REFERENCES

- Anchor QEA, 2011. *Final Engineering Evaluation/Cost Analysis – Jorgensen Forge Facility, 8531 East Marginal Way South, Seattle, Washington*. Prepared for the U.S. Environmental Protection Agency. March 2011.
- EMJ (Earle M. Jorgensen), Jorgensen Forge Corporation, and The Boeing Company, 2007. *Memorandum of Understanding: Coordination at the Boeing and EMJ/Jorgensen Transition Zone Boundary Sediment Cleanup Areas; Lower Duwamish Waterway (MOU)*. September 2007.
- EPA (U.S. Environmental Protection Agency), 2008. Letter with Subject: Target Remedial Sediment Boundary, Vertical Point of Compliance and Target Sediment Cleanup Level, Administrative Order on Consent, Jorgensen Forge Facility, Tukwila, Washington, Comprehensive Environmental Response, Compensation and Liability Act, as amended, EPA Docket No. CERCLA 10-2003-0111. Prepared for Mr. Peter Jewett of Farallon Consulting, LLC, and Mr. William Johnson of Earle M. Jorgensen Company. August 8, 2008.
- EPA, 2011. *Action Memorandum for a Non-Time-Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington*. Seattle, Washington.

FIGURES

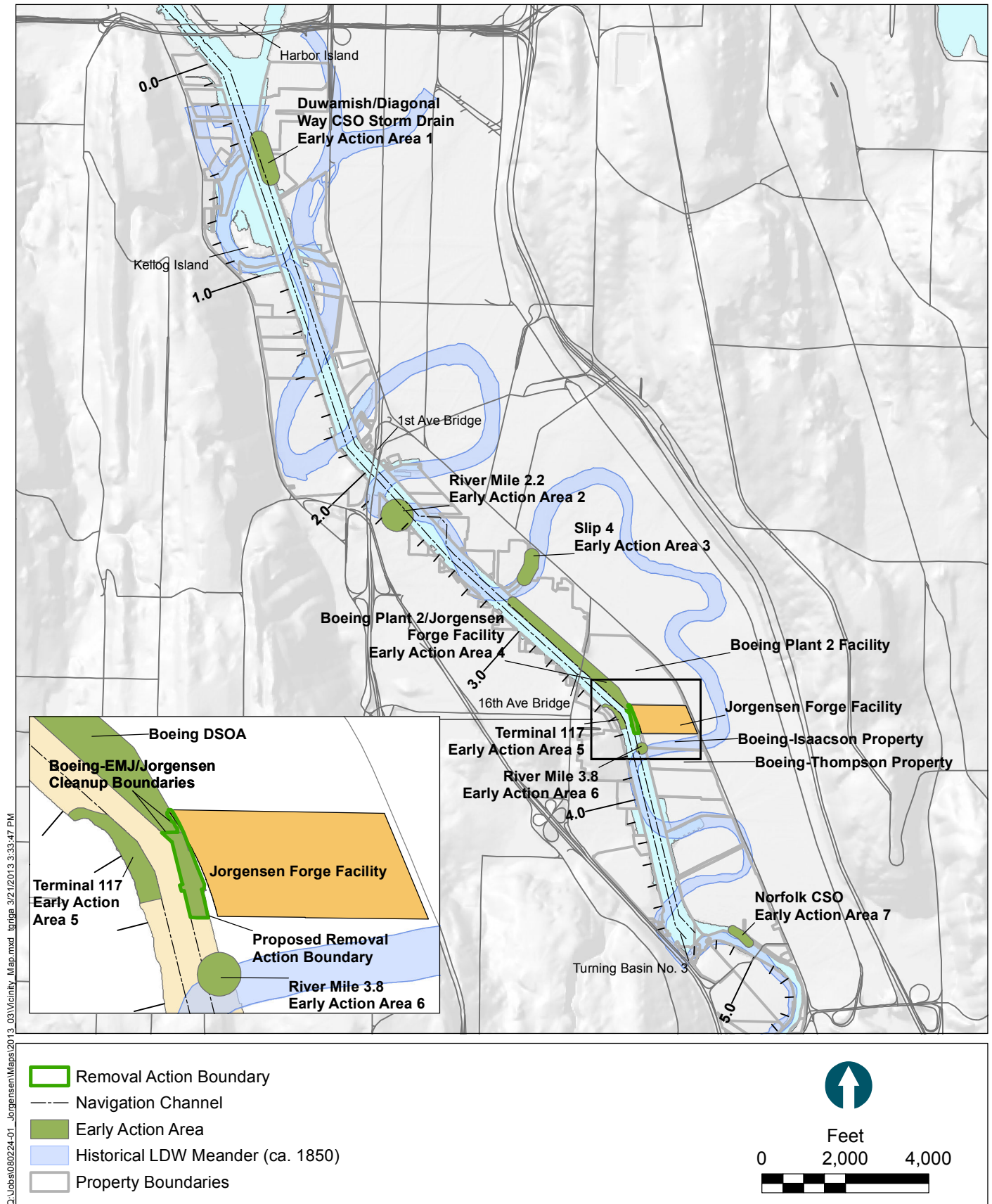


Figure 1
Removal Action Vicinity Map
Field Sampling Plan
Jorgensen Forge Early Action Area

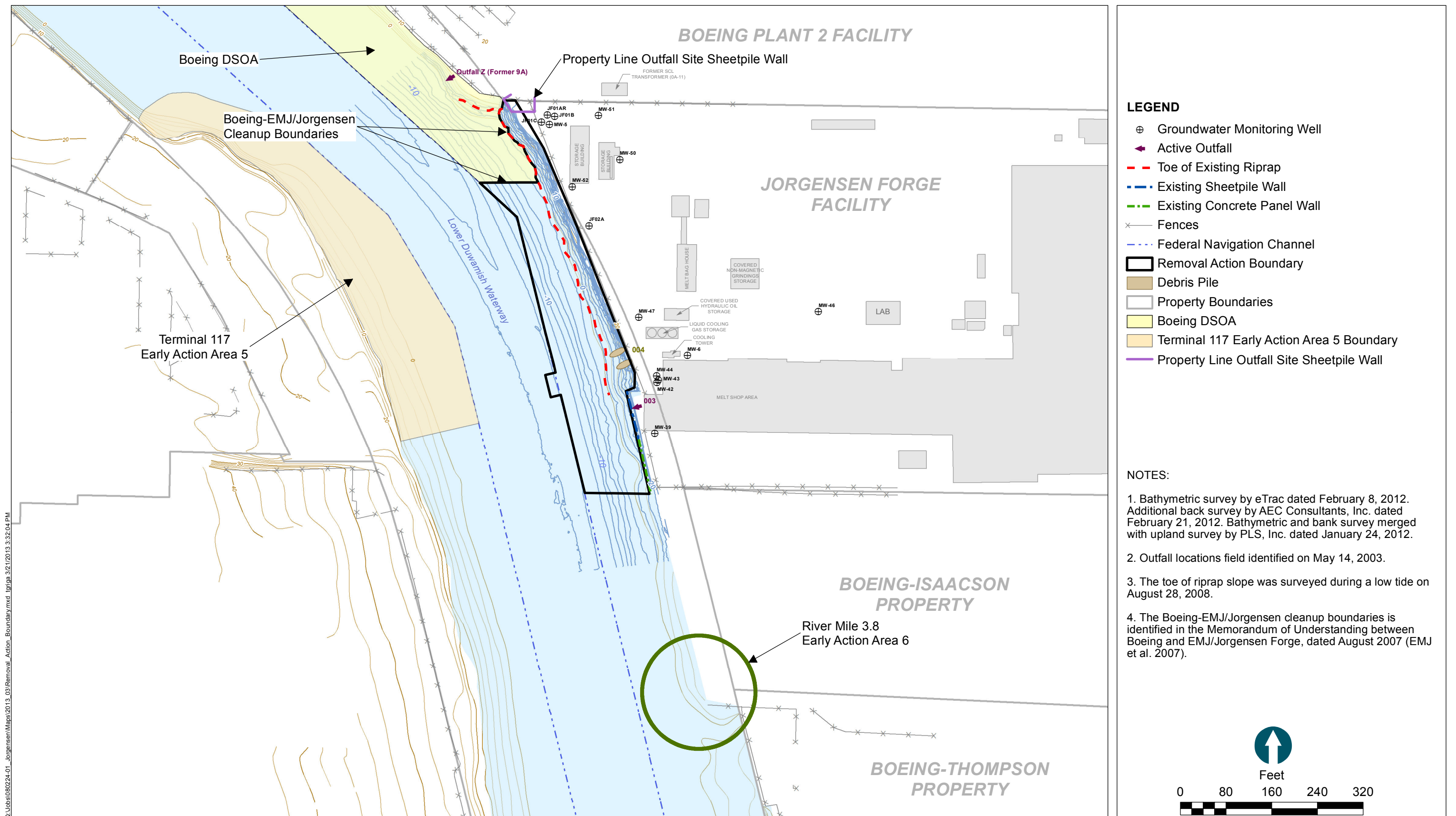


Figure 2
Removal Action Boundary
Field Sampling Plan
Jorgensen Forge Early Action Area

ATTACHMENT 1
SEDIMENT CORE COLLECTION LOG



Sediment Core Collection Log

Page ___ of ___

Job: _____
Job No: _____
Field Staff: _____
Contractor: _____
Vertical Datum: _____

Station ID: _____
Attempt No. _____
Date: _____
Logged By: _____
Horizontal Datum: _____

Field Collection Coordinates:
Lat/Northing: _____

Long/Easting: _____

A. Water Depth

DTM Depth Sounder: _____
DTM Lead Line: _____

B. Water Level Measurements

Time: _____
Height: _____
Source: _____

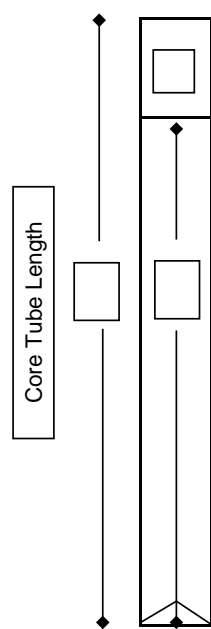
C. Mudline Elevation

Recovery Measurements (prior to cuts)

Core Collection Recovery Details:

Core Accepted: Yes / No
Core Tube Length: _____
Drive Penetration: _____
Headspace Measurement: _____
Recovery Measurement: _____
Recovery Percentage: _____
Total Length of Core To Process: _____

Drive Notes:



Sections To Process:

A: _____
B: _____
C: _____
D: _____

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:

ATTACHMENT 2

VISUAL OBSERVATION LOG



Visual Observations Log Form

Date _____

Project Number: _____

Location: _____

Project Name: _____

Monitoring Period: _____

Time Observations
Started: _____

Time
Observation
Concluded: _____

Weather Conditions:

Photographs Taken: Yes No

Tidal Conditions:

Observations of Erosion,
Soughing or Instability:

Observations of Habitat Layer
Condition:

Evidence of Armor
Movement?

Other Comments:

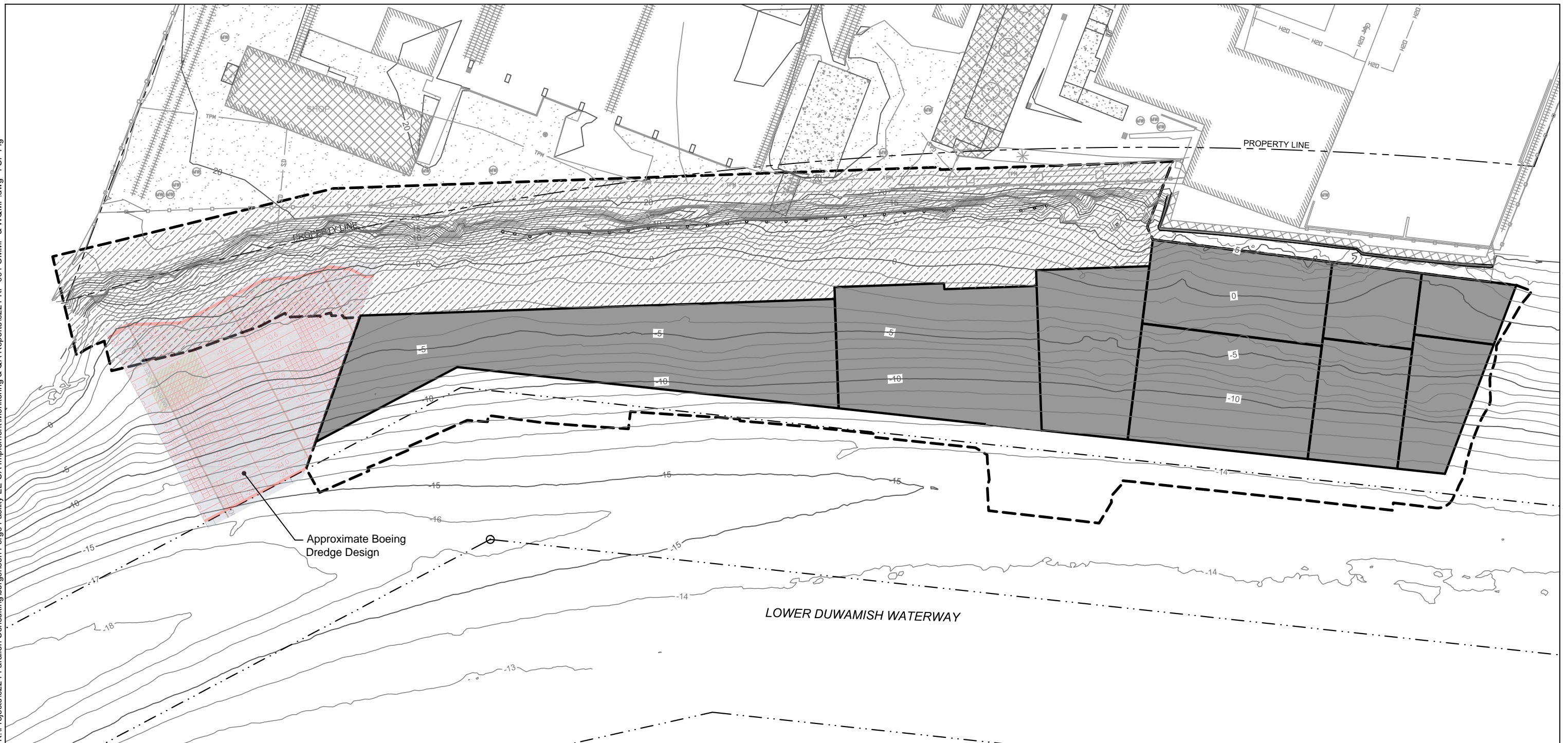
Recorded by:

ATTACHMENT 3

SITE MAP VISUAL MONITORING FORM

K:\Projects\0224-Farallon Consulting\Jorgensen Forge Facility EE-CA Implement\Monitoring & QA Reports\0224-RP-001 OMMP & WQMP.dwg FSP Fig

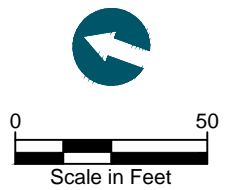
May 23, 2012 10:57am tgriga



HORIZONTAL DATUM: Washington State Plane North, NAD83.
VERTICAL DATUM: Mean Lower Low Water (MLLW).

LEGEND:

- | | |
|------------------------------------|----------------------------------|
| --- -- Navigation Channel | Backfill Material Placement Area |
| 5 Existing Contour (1 Ft Interval) | Shoreline Containment Area |
| --- Dredge/Excavation Limits | |



Date _____ Time _____ Recorded By _____

Site Map Visual Monitoring Form
Jorgensen Forge Early Action Area